APPENDIX 4B
RSS QUALIFICATION, ACCEPTANCE, AND AGE SURVEILLANCE TEST APPENDIXES

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INTRODUCTION TO RSS COMPONENT QUALIFICATION, ACCEPTANCE, AND AGE SURVEILLANCE TEST APPENDIXES

4B.1 Introduction to the Appendix

This appendix provides applicable RSS component qualification, acceptance, and age surveillance test requirements.

4B.2 Organization

The test appendixes are organized into two separate sections with the exceptions of Appendix 4B1 and 4B11. The first section presents the environmental testing sequences. The second section presents the unique test requirements for the given component.

Where applicable, the purpose, conditions, procedure, and pass/fail criteria for the conduct of the unique tests are described to provide guidance to the Range User.

4B.3 Tailoring

The test requirements of Appendixes 4B1 through 4B14 may be tailored to fit the specific hardware design and application. The tests described in the appendixes are not intended to be fully applicable to every RSS system or component. Coordination with Range Safety will permit the application of sound, technically justified, tailoring criteria.

The rationale for all tailoring shall be ultimately submitted to Range Safety in writing for approval prior to requesting test plan and test procedure approval by Range Safety. Other additional tests not contained in these appendixes may be required for new technology and/or unique applications of existing technology.

In addition, non-operating environment tests are not required if it can be shown that the operating test environment includes the non-operating environment.

4B.4 Test Plan and Test Procedure Requirements

The Range User shall establish procedures for performing all required tests in accordance with detailed test plans approved by Range Safety.

The test plan shall indicate the test requirements, testing approach for each component, related special test equipment, facility and system interface requirements. Traceability shall be provided from the specified requirements to the test procedures.

The test procedures shall cover all operations in enough detail so that there is no doubt as to what is to be done. The pass/fail test criteria shall be determined prior to the start of every test.

4B.5 Testing Sequence

Unless otherwise agreed to by Range Safety, the testing sequences shall conform to those described in the test appendixes.

4B.6 Retest Requirements

In the case of a significant redesign of a component, all previous qualification tests, including acceptance tests, shall be repeated. Where the redesign or rework of the component is very minor, it may be acceptable to Range Safety to only repeat functional testing and the test in which the failure occurred.

4B.7 Failure to Meet Component Specifications

The failure of an RSS component to meet Range Safety approved specifications shall be reported to Range Safety verbally within 72 h and then in writing within 14 calendar days of the date the failure is noted. **NOTE:** Components whose test data reflect the unit is out-of-family when compared to other units shall be considered as out of specification.

A component that exhibits any sign that a part is stressed beyond its design limit (cracked circuit boards, loose connectors and/or screws, bent clamps and/or screws, worn parts) is considered a failure of the component even if the component passes the final functional test.

If a test discrepancy occurs, the test shall be interrupted, the discrepancy verified, and Range Safety

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shall be verbally notified within 24 h. If the discrepancy is dispositioned as a failure in the item under test, the preliminary failure analysis and appropriate corrective action plan shall be submitted to Range Safety before testing is resumed.

The failure analysis shall include the cause of the failure, the physics of the failure, and isolation of the failure to the smallest replaceable item(s). The degree of retest shall be determined for each case based upon the nature of the failure. The failure analysis plan shall be developed and approved by Range Safety before the test configuration can be broken.

4B.8 Testing Prior to Qualification

Prior to the start of qualification testing, the component shall satisfactorily pass the acceptance test.

4B.9 Test Tolerances

The test tolerances allowed in Appendixes 4B1 through 4B14 shall be applied to the nominal test values specified. Unless otherwise specified, the maximum allowable tolerances shown in Table 4B-1 shall apply.

Table 4B-1
Test Tolerances

Temperature	±3°C
Pressure Above 1.3 x 10^2 Pascals (1 Torr) 1.3 x 10^{-1} to 1.3 x 10^2 Pascals (0.001 Torr to 1 Torr) Less than 1.3 x 10^{-1} Pascals (0.001 Torr)	±10% ±25% ±80%
Relative Humidity	±5%
Acceleration	±10%
Vibration Frequency	±2%
Sinusoidal Vibration Amplitude	±10%
Random Vibration Power Spectral Density (G^2/Hz) 20 to 100 Hz (5 Hz or narrower bands) 100 to 500 Hz (25 Hz or narrower bands) 500 to 2000 Hz (50 Hz or narrower bands)	±1.5 dB ±1.5 dB ±1.5 dB
Sound Pressure Level 1/3 Octave Band Overall	±3.0 dB ±1.5 dB
Shock Response Spectrum (Q = 10) 1/6 Octave Band Center Frequency Amplitude	+6 dB - 3 dB
Static Load	±5%

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4B1.1 General Requirements

This appendix contains common test requirements for all RSS components. Some of the tests may not be applicable to all components. For example, the functional test prior to, during, and after environmental exposure is not applicable to the ordnance component. Pre- and post-environmental data shall be compared for any significant changes.

4B1.2 Product Examination

4B1.2.1 Visual Inspection

a. Purpose. To ensure that good workmanship has been employed and that the component is free of obvious physical defects.

b. Procedure. Visually inspect components before and after each manufacturing, handling, storage, and test operation.

1. With the unaided eye, inspect all accessible areas of the component.

2. Under 10X minimum magnification, inspect all critical surfaces and interfaces of the component.

c. Pass/Fail Criteria. Components shall be of good workmanship and free of obvious physical defects.

4B1.2.2 Weight

a. Purpose. To ensure that the weight of the component is within the weight limits that are specified in the component specification.

b. Procedure

1. Physically weigh the component.

2. Record weight reading in the component travel package.

c. Pass/Fail Criteria. Weight limits shall be in accordance with the component specification.

4B1.2.3 Dimension

a. Purpose. To ensure that the component configuration is within the dimensional limits that are specified in the applicable component specification.

b. Procedure

1. Physically measure the component.

2. Record dimensions in the component travel package.

c. Pass/Fail Criteria. The component configuration shall be in accordance with the dimensional limits that are specified in the component specification.

4B1.2.4 Identification

a. Purpose. To ensure that the component identification tag contains the applicable information as required by the component specification.

b. Procedure. As applicable, check identification tags to verify:

1. Component name

2. Manufacturer identification

3. Date of manufacture

4. Date of explosive loading for components containing explosives

5. Serial number

6. Part number

7. Shelf life

8. Service life

4B1.2.5 X-Ray

a. Purpose. To nondestructively inspect the internal parts of a component.

b. Procedure. Perform X-ray radiographic tests in accordance with MIL-STD-453 or the equivalent. **NOTE**: The components shall be X-rayed to qual-ity level 2-2T of MIL-STD-453 or the equivalent unless otherwise specified in the component specification.

c. Pass/Fail Criteria. The X-ray evaluation shall be in accordance with the accept/reject criteria that is established by the component specification.

4B1.2.6 N-Ray

a. Purpose. To nondestructively inspect the internal nonmetallic components of explosive components. **NOTE:** N-ray radiographic testing shall conform to the requirements of ASTM E 748.

b. Pass/Fail Criteria. N-ray inspection shall be in accordance with the accept/reject criteria established by the component specification.

4B1.2.7 Leakage

a. Purpose. To demonstrate the capability of a component to meet the component design leakage rate.

b. Procedure. Perform leak rate tests in accordance with the requirements of MIL-STD-202, Method 112, Procedure III or IV or the equivalent.

c. Pass/Fail Criteria. The leak rate shall not component specification.

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4B1.3 Non-Operating Environment

4B1.3.1 Storage Temperature

a. Purpose. To determine the ability of the test component to withstand high and low temperature conditions during all storage conditions without degradation in performance

b. Conditions

1. The minimum storage temperature range is -34°C to +71°C.

2. The test item shall be in its approved storage configuration.

c. Procedure

1. Expose the component to the high and low temperatures for a minimum of 7 cycles and a 12 h dwell at each temperature extreme.

2. Visually inspect the component for any signs of deterioration.

d. Pass/Fail Criteria. The component performance shall not degrade after it has been exposed to the test temperatures.

4B1.3.2 High Temperature Exposure

a. Purpose. To determine the ability of the dev-ice to withstand exposure to high temperature.

b. Condition. The item shall be placed in an oven preheated to 30° above the maximum predicted temperature during service life, but not less than 71°C for a period of 1 h.

c. Procedure. Dissect the item and visually inspect for any decomposition and/or degradation.

d. Pass/Fail Criteria. The item shall not autoignite or decompose as a result of this exposure.

4B1.3.3 Transport Shock/Bench Handling

To ensure that the test component can withstand the relatively infrequent, non-repetitive shocks encountered in handling, transportation, and service.

4B1.3.3.1 Transportation Shock Test

a. Conditions

1. The test component shall be packaged in the manner intended for shipment.

2. The test component shall be oriented so that, upon impact, a line from the impacting corner or edge to the center of gravity of the transportation case and the component is perpendicular to the impact surface.

3. Drops shall be made from a quick-release hook or drop tester.

b. Procedure. Drop each corner, each flat face, and each edge of the component from a height of 48 in. onto a concrete surface.

c. Pass/Fail Criteria. The component shall not be damaged and shall be capable of meeting the performance requirements of its specification.

4B1.3.3.2 Bench Handling Shock

a. Condition. The test component shall be unpacked and in a ready-to-use configuration.

b. Procedure

1. Configure the item as it would be for servicing.

2. Position the item as it would be for servicing.

3. Using one edge as a pivot, lift the opposite edge of the chassis until one of the following conditions occurs:

(a) The chassis forms an angle of 45° with the horizontal bench top

(b) The lifted edge of the chassis has been raised 4 in. above the horizontal bench top

4. Let the item drop freely to the solid wood bench top.

5. Repeat, using other edges of the same horizontal face as pivot points, for a total of four drops.

6. Repeat *3* above with the test item resting on other faces until it has been dropped for a total of four times on each face on which the test item could be placed practically during servicing. **NOTE:** The test item shall not be operating.

7. Visually inspect the test item.

c. Pass/Fail Criteria. The component shall be capable of meeting the performance requirements of its specification.

4B1.3.4 Transportation Vibration

a. Purpose. To ensure that the component can withstand the transportation environment that may be encountered during logistic transportation conditions on the land, on the sea, and in the air.

b. Conditions

1. The component shall be packaged in the manner intended for shipment.

2. The test duration shall be 60 min minimum per axis.

c. Procedure. Expose each axis of the component

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to the levels listed below:
0.01500 g^2/Hz at 10 Hz to 40 Hz
0.01500 g^2/Hz at 40 Hz to 0.00015 g^2/Hz at 500 Hz

NOTE: If the test component is resonant below 10 Hz, extend the curve to the lowest resonant frequency.

d. Pass/Fail Criteria. The component shall be capable of meeting the performance requirements of its specification.

4B1.3.5 Fungus Resistance

a. Purpose. To determine that the component will resist fungal growth or if fungal growth occurs, the growth will not affect the performance of the component.

b. Procedure. Perform the fungal resistance test in accordance with MIL-STD-810, Method 508.4 or the equivalent.

c. Pass/Fail Criteria. The component shall be inspected in accordance with criteria stated in the component specifications.

4B1.3.6 Salt Fog

a. Purpose. To determine the ability of the test component to resist the effects of a moist, salt-laden atmosphere. This test is applicable to any component that will be exposed to salt fog conditions while in service.

b. Condition. The component shall be completely unpacked and in a ready-to-use configuration.

c. Procedure

1. Perform a full functional test of the component and record the test results.

2. Place the test component in a test chamber and expose the component to 5 percent salt fog at 35°C for a period of 48 h.

3. At the end of the exposure period, inspect the component for corrosion.

4. Store the test component in ambient atmosphere for 48 h.

5. At the end of the ambient stage period, operate the test component again and compare the results with the data collected prior to the start of the test. **NOTE**: If required, the test component may be gently washed in running water not warmer than 38°C.

d. Pass/Fail Criteria

1. The component shall be capable of meeting the performance requirements of the component specification.

2. The component performance shall not vary from the data that was collected during the full functional test prior to the start of the test.

4B1.3.7 Fine Sand

a. Purpose. To determine the ability of the test item to resist the effects of dust or fine sand particles that may penetrate into cracks, crevices, and bearings and joints causing degradation of the performance, effectiveness, and reliability of the component.

b. Conditions

1. The test item shall be in a configuration that would allow it to be exposed to dust and fine sand conditions (in a shipping or storage container, a transit case, ready to use).

2. Relative humidity shall not exceed 30 percent.

3. Silica sand, at least 95 percent by weight S_iO_2, shall be used as the test medium. The size distribution as determined by weight using the US Standard Sieve Series shall be as follows:

(a) 1 percent shall be retained by a 20 mesh screen

(b) 1.7 percent shall be retained by a 30 mesh screen

(c) 14.8 percent shall be retained by a 40 mesh screen

(d) 37.0 percent shall be retained by a 50 mesh screen

(e) 28.6 percent shall be retained by a 70 mesh screen

(f) 12.7 percent shall be retained by a 100 mesh screen

(g) 5.2 percent shall pass through a 100 mesh screen

c. Procedure

1. Expose each face of the test item to a sand dust having a velocity of 18 to 29 meters per second for a total of 90 min per face.

2. If operation of the test item is required, continuously operate the test item for a minimum of 10 min during the last period of the test.

3. Visually inspect the component for abrasion, clogging effects, and any evidence of sand penetration.

d. Pass/Fail Criteria

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1. The performance of the test item shall not be degraded.

2. Abrasion of the test item shall not exceed the amount specified in its component specification.

4B1.3.8 Pull

The purpose of the following tests is to verify the capability of the components to withstand handling tensile loads without damage or degradation of performance.

4B1.3.8.1 Initiator

EED Initiator Pins and EBW initiator pins (terminals) shall be capable of withstanding an axial pull of at least 18 lb for not less than 1 min without damage or degradation in performance.

4B1.3.8.2 ETS, FOCA, LIDs Pigtail, and Optical Connector

a. Conditions

1. 100 lb tensile load for qualification test

2. 50 lb tensile load for acceptance test

b. Pass/Fail Criteria. The component and its asso-ciated fittings shall be capable of withstanding ten-sile loads, as stated in the Condition, for 1 min minimum without damage or degradation in performance.

4B1.3.8.3 Destruct Charge

a. Conditions

1. 50 lb for qualification test

2. 25 lb for acceptance test

b. Pass/Fail Criteria. The component and associated fittings shall be capable of withstanding tensile loads, as stated in the Condition, for 1 min minimum without damage or degradation in performance.

4B1.3.9 6-ft Drop

To demonstrate that the component will not initiate when dropped from a height of 6 ft and that it will perform to specification after impact.

4B1.3.9.1 Initiator

a. Conditions

1. The initiator shall be dropped onto a 1/2-in. thick steel plate from a height of 6 ft.

2. The initiator shall be dropped twice.

b. Procedure

1. Drop the initiator to cause it to impact on the output end. This is drop 1 of 2.

2. Drop the initiator to cause it to impact on its side. This is drop 2 of 2.

c. Pass/Fail Criteria. The detonator shall not fire, dud, or deteriorate in performance as a result of this test.

4B1.3.9.2 ETS

a. Procedure. Drop the component onto a 1/2-in. thick steel plate from a height of 6 ft.

b. Pass/Fail Criteria

1. The component shall not detonate and it shall remain safe to handle.

2. The component shall function after the test if the effects of the test are not detectable.

4B1.3.9.3 Destruct Charge

a. Procedure. Drop the component onto a 1/2-in. thick steel plate from a height of 6 ft.

b. Pass/Fail Criteria

1. The component shall not detonate and it shall remain safe to handle.

2. The component shall function after the test if the effects of the test are not detectable.

4B1.3.10 40-ft Drop

a. Purpose. To demonstrate that the components will not initiate when dropped from a height of 40 ft and will be safe to handle.

b. Procedure. Drop the component onto a 1/2-in. thick steel plate from a height of 40 ft.

c. Pass/Fail Criteria. The component shall not detonate and shall remain safe to handle. The component is not required to function after the test.

4B1.4 Operating Environment

4B1.4.1 Qualification

4B1.4.1.1 Sinusoidal Vibration

a. Purpose

1. To demonstrate the ability of the component to withstand or, if appropriate, to operate at the design levels of the sinusoidal or decaying sinusoidal type dynamic vibration environment that is specified for the component.

2. To determine any resonant conditions that could result in failure in flight or in subsequent vibration tests.

b. Conditions

1. A full functional test shall be conducted

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before and after the completion of the sinusoidal vibration test.

2. Critical parameters, as agreed to by Range Safety, shall be continuously monitored for failures or intermittents during the vibration test.

3. When monitoring during the vibration test is not practical, a limited functional test shall be performed after the vibration test for each axis.

4. The component shall be tested in each of 3 mutually perpendicular axes. Significant resonant frequencies in each of these axes shall be noted and recorded.

5. As applicable, the component shall be mounted, including dynamic isolator (if used), as in flight configuration with flight-type support structure, hardware, cable, and explosive transfer line (ETL).

6. The induced cross axis acceleration at the attach points should be limited to the maximum test levels specified for the cross axes.

7. Tests that are conducted to determine resonant conditions shall be conducted using test levels and duration that are sufficient to provide diagnostic capability.

8. Sinusoidal excitation may be applied as a dwell at discrete frequencies or as a frequency sweep with the frequency varying at a logarithmic rate.

9. The sweep rate for diagnostic tests shall be slow enough to allow identification of significant resonances.

10. Tests that are conducted to demonstrate the degree of ruggedness shall be a duration of 2 min per octave unless the sweep rates and dwell times can be based on the persistence of the environment in in-service use.

11. The vibration level shall be at 6 dB above the maximum predicted environment.

c. Pass/Fail Criteria. The test component shall be capable of meeting the requirements of the applicable specification*(s)* without any physical damage or degradation of performance.

4B1.4.1.2 Random Vibration

a. Purpose. To determine if the test component will continue to operate in an environment with a vibration level at 6 dB above the maximum predicted environment (MPE) and to ensure that the acceptance will not damage the flight unit.

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4B1.4.1.2.1 Hard Mounted Components.

a. Conditions

1. A full functional test shall be conducted before and after the completion of the random vibration test.

2. During the random vibration test, electrical and electronic components, including redundant circuits, shall be electrically energized and functionally sequenced through various operational modes to the maximum extent possible.

3. Critical parameters, as agreed to by Range Safety, shall be continuously monitored for failures or intermittents during the random vibration test.

4. Where insufficient time is available at the full test level to test all functions and modes, extended testing at a level 6 dB lower shall be conducted as necessary to complete functional testing.

b. Procedure

1. Mount the component as in flight configuration with flight-type support structure, bracket, hardware, cable, and ETL, as applicable.

2. Vibrate the component in each of three orthogonal axes.

3. The vibration test duration in each of the three orthogonal axes shall be 3 times the expected flight exposure time to the MPE or 3 times the component random vibration acceptance test time if that time is greater, but not less than 3 min per axis.

4. The minimum vibration test level shall be 6 dB above the MPE; however, the power spectrum density shall not fall below that shown in Table 4B1-1.

Table 4B1-1
Minimum Power Spectral Density
For Qualification Random Vibration

Frequency Range	Minimum Power Spectral Density
20	0.021 g^2/Hz
20 - 150	3 dB/OCTAVE SLOPE
150 - 600	0.16 g^2/Hz
600 - 2000	-6 dB/OCTAVE SLOPE
2000	0.014 g^2/Hz
Overall GRMS = 12.2	

c. Pass/Fail Criteria. The test component shall be capable of meeting the requirements of the applicable specification*(s)* without any physical damage or degradation in performance.

4B1.4.1.2.2 Isolator Mounted Components.

a. Conditions

1. A full functional test shall be conducted before and after the completion of the random vibration test.

2. During the random vibration test, electrical and electronic components, including redundant circuits, shall be electrically energized and functionally sequenced through various operational modes to the maximum extent possible.

3. Critical parameters, as agreed to by Range Safety, shall be continuously monitored for failures or intermittents during the random vibration test.

4. Where insufficient time is available at the full test level to test all functions and modes, extended testing at a level 6 dB lower shall be conducted as necessary to complete functional testing.

5. The isolator shall have passed the acceptance test in accordance with the requirements in Appendix 4B11.

6. The component shall be qualification tested in both hard mounted and isolated mounted configuration. **NOTE:** The hard mounted test is to ensure that subsequent acceptance tests will not damage the hardware. The isolated mounted test is to qualify the interfaces in flight configuration.

b. Hard Mount Procedure

1. Mount the component as in flight configuration with flight-type support structure, bracket, hardware, cable, ETL (as applicable) and without the isolator.

2. Vibrate the component in each of three orthogonal axes.

3. The vibration test duration in each of the three orthogonal axes shall be 3 times the expected flight exposure time to the MPE or 3 times the component random vibration acceptance test time if that time is greater, but not less than 3 min per axis.

4. The random vibration power spectrum density (PSD) used for this test shall be obtained as follows: (See also Figure 4B1-1)

(a) Using either the mass simulator, development or flight unit with the isolator

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mounted in flight configuration with flight-type cable, ETL (as applicable), vibrate the unit at 3 orthogonal axes at the component maximum MPE for 1 min for each axis.

(b) Obtain the unit response PSD and envelop all 3 axes into one composite curve A.

(c) Obtain a new PSD curve B by adding 1.5 dB to Curve A.

(d) Compare PSD curve B to the minimum PSD for acceptance as is shown in Table 4B1-2.

(e) Create a new curve by enveloping the most stringent value of both curves. **NOTE:** This new PSD curve (curve C) becomes the PSD for acceptance testing.

(f) Obtain a qualification PSD (curve D) by adding 6 dB to curve C.

c. Isolator Mount Procedure

1. Mount the component as in flight configuration with flight-type support structure, hardware, cable, ETL (as applicable), and brackets.

2. Vibrate the component in each of three orthogonal axes.

3. The vibration test duration in each of the three orthogonal axes shall be 3 times the expected flight exposure time to the MPE or 3 times the component random vibration acceptance test time if that time is greater, but not less than 3 min per axis.

4. The minimum vibration input test level at the isolator shall be 6 dB above the MPE; however, the PSD shall not fall below that shown in Table 4B1-1.

d. Pass/Fail Criteria. The test component shall be capable of meeting the requirements of the applicable specifications without any physical damage or degradation in performance.

4B1.4.1.3 Acoustic

a. Purpose. To determine if the test component will continue to operate in an environment with a sound pressure level at 6 dB above the MPE.

b. Conditions

1. A full functional test shall be conducted before and after the completion of the acoustic vibration test.

2. During the acoustic vibration test, electrical and electronic components, including redundant circuits, shall be electrically energized and functionally sequenced through various operational modes to the maximum extent possible.

3. Critical parameters as agreed to by Range Safety shall be continuously monitored for failures

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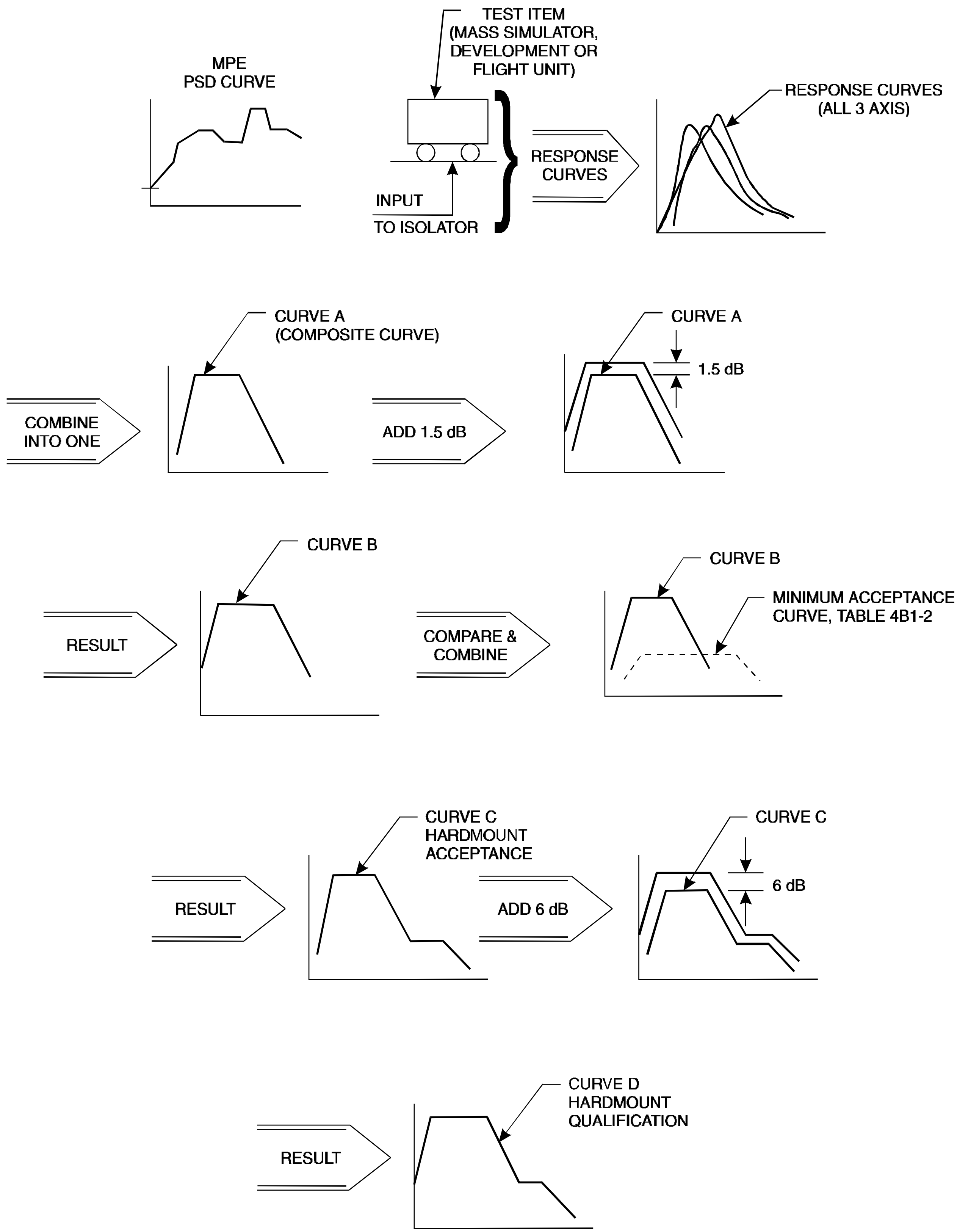

Figure 4B1-1
Obtaining Power Spectrum Density

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or intermittents during the acoustic vibration test.

4. The component shall be installed in a reverberant acoustic cell capable of generating desired sound pressure level.

5. As applicable, the component shall be mounted, including dynamic isolator (if used), as in flight configuration with flight-type support structure, hardware, cable, ETL, and brackets.

6. The sound pressure level shall be at the designed level (6 dB above the MPE), but not less than 144 dBA overall.

7. The test duration shall be 3 times the expected flight exposure time to the MPE or 3 times the acoustic acceptance test duration, whichever is greater, but not less than 3 min.

8. Where there is insufficient time at the full test level to test all functions and modes, extended testing at a level 6 dB lower shall be conducted as necessary to complete functional testing.

c. Pass/Fail Criteria. The test component shall be capable of meeting the requirements of the applicable specification*(s)* without any physical damage or degradation in performance.

4B1.4.1.4 Shock

a. Purpose. To determine if the test component can withstand shock in each direction along each of the 3 orthogonal axes at the maximum predicted level plus 6 dB or a minimum of 1300 g.

b. Conditions

1. A full functional test shall be performed before and after all shock tests and several critical parameters continuously monitored during the shocks to evaluate performance and to detect any failures.

2. A visual inspection shall be made before and after the test.

3. The visual inspection shall not entail the removal of components covers nor any disassembly.

4. The proposed test method shall be validated prior to conducting tests on the flight component.

5. Any test technique that is used shall, as a minimum, provide the following:

(a) A transient with the prescribed shock spectrum can be generated within specified tolerances and

(b) The applied shock transient provides a simultaneous application of the frequency components as opposed to a serial application.

6. As applicable, the component shall be mounted, including dynamic isolator (if used), as in flight configuration with flight-type support structure, hardware, cable, ETL, and brackets.

7. The shock spectrum in each direction along each of the 3 orthogonal axes shall be at least the maximum predicted level plus 6 dB or a minimum of 1300 G, whichever is greater, for that direction.

8. The minimum number of shocks shall be 3 times per axis for each direction, positive and negative, for a total of 18 shocks.

9. The duration shall simulate the actual event.

10. The minimum frequency range shall be from 100 to 10,000 Hz.

c. Pass/Fail Criteria. The test component shall be capable of meeting the requirements of the applicable specification*(s)* without any physical damage or degradation in performance.

4B1.4.1.5 Acceleration

a. Purpose. To determine if the test component can withstand an acceleration level at least twice the maximum predicted levels or a minimum of 20 G in each direction for each of the 3 orthogonal axes.

b. Conditions. **NOTE:** If the peak acceleration is less than 3 times the square root of G (where G is the integrated area from 0 to 0.8 times the natural frequency response of a randomly vibrated system), then the random vibration test can usually be accepted in lieu of an acceleration test.

1. A full functional test shall be conducted before the acceleration test and after completion of the test.

2. Electrical components shall be powered during the test and critical parameters continuously monitored for failures or intermittents.

3. As applicable, the component shall be mounted, including dynamic isolator (if used), as in flight configuration with flight-type support structure, bracket, hardware, cable, and ETL.

4. The component shall be tested in each of 3 mutually perpendicular axes.

5. The specified accelerations apply to the geometric center of the test component.

6. If a centrifuge is used, the arm measured to the geometric center of the test component shall be at least 5 times the dimension of the test component

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measured along the arm.

7. The test acceleration level shall be at least twice the maximum predicted levels or 20 G, whichever is greater, in each direction for each of the 3 orthogonal axes.

8. The duration of the test shall be five min per each axis in each direction.

c. Pass/Fail Criteria. The test component shall be capable of meeting the requirements of the applicable specification*(s)* without any physical damage or degradation in performance.

4B1.4.1.6 Humidity

a. Purpose. To determine if the test component is capable of surviving without excessive degradation when exposed to humidity during fabrication, test, shipment, storage, and launch operations.

b. Conditions

1. A full functional test shall be conducted before the humidity test and at the end of Cycle 3 and visually inspected for deterioration or damage.

2. The component shall also be functionally tested during the Cycle 4 periods of stability.

3. The component shall be placed in a chamber to simulate the normal installation.

4. Chamber temperature shall be at normal room ambient conditions with uncontrolled humidity.

5. The component shall be visually inspected for deterioration or damage after removal from the chamber.

c. Procedure

1. Cycle 1

(a) Increase the temperature to 35°C over a 1 h period.

(b) Increase the humidity to not less than 95 percent over a 1 h period with the temperature maintained at 35°C.

(c) Maintain temperature and humidity for 2 h.

(d) Reduce the temperature to 2°C over a 2-h period with the relative humidity stabilized at not less than 95 percent.

(e) Maintain these conditions for 2 h.

2. Cycle 2. Repeat cycle one with the following exception: *Increase the temperature from 2°C to 35°C over a 2 h period and do not add moisture to the chamber until 35°C is reached.*

3. Cycle 3

(a) Increase the chamber temperature to 35° C over a 2 h period without adding any moisture to the chamber.

(b) Dry the component with air at room temperature and 50 percent maximum relative humidity (RH) by blowing air through the chamber for 6 h. The volume of air that is used per minute shall be equal to 1 to 3 times the test chamber volume. A suitable container may be used in place of the test chamber for drying the component.

(c) Visually inspect the component for physical damage or deterioration.

(d) Perform a full functional test.

4. Cycle 4

(a) Place the component in the test chamber and increase the temperature to 35°C and increase RH to 90 percent over a 1 h period.

(b) Maintain these conditions for at least 1 h.

(c) Perform a full functional test.

(d) Reduce the temperature to 2°C over a 1 h period with the RH stabilized at 90 percent.

(e) Maintain these conditions for at least 1 h.

(f) Perform a full functional test.

(g) Perform a drying cycle in accordance with cycle 3.

d. Pass/Fail Criteria. The test component shall be capable of meeting the requirements of the applicable specification*(s)* without any physical damage or degradation in performance.

4B1.4.1.7 Thermal Cycle

a. Purpose. To demonstrate the ability of the component to operate over the design temperature range and to survive the thermal cycling screening test that is imposed upon the component during acceptance testing.

b. Conditions

1. Full Functional tests shall be conducted during the 1, 2, 12, 13, 23, and 24 thermal cycles at high and low temperatures and after return of the component to ambient.

(a) The functional test at the 1 and 23 cycle shall be performed at high voltage input.

(b) The functional test at the 2 and 24 cycle shall be performed at low voltage input.

(c) The functional test at the 12 and 13 cycle

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shall be performed at nominal voltage input.

2. During the remainder of the test, electrical components, including all redundant circuits, shall be cycled through various operational modes and critical parameters monitored for failures and intermittents. These tests shall be performed at the nominal voltage input.

3. Pressure

(a) Ambient pressure shall normally be used unless testing is performed to the requirements of paragraph 3*(c)* below.

(b) When unsealed components are being tested, the chamber may be flooded with dry air or nitrogen to preclude condensation on and within the component at low temperature.

(c) This test may be performed in a thermal vacuum and combined with the thermal vacuum tests, provided that the temperature limits, number of cycles, rate of temperature change, and dwell times conform to this test.

4. Temperature

(a) Non-Ordnance. The component temperatures shall be at the maximum flight predicted high temperature plus 10^{o}C or 71^{o}C, whichever is higher, during the hot cycle and at the maximum flight predicted low temperature minus 10^{o}C or -34^{o}C, whichever is lower, during the cold cycle.

(b) Ordnance. The component temperatures shall be at the maximum flight predicted high temperature plus 10^{o}C or 71^{o}C, whichever is higher during the hot cycle and at the maximum flight predicted low temperature minus 10^{o}C or -54^{o}C, whichever is lower during the cold cycle.

5. Duration

(a) Non-Ordnance. Three times the number of thermal cycles as used for acceptance testing but not less than 24 cycles total. Each cycle shall have a 1 h minimum dwell at the high and at the low temperature levels during which the unit shall be turned off until the temperature stabilizes and then turned on. The dwell time at the high and low levels shall be long enough to obtain internal thermal equilibrium. The test unit transitions between low and high temperatures shall be at an average rate of at least 1^{o}C per min.

(b) Ordnance. The minimum number of thermal cycles testing shall not be less than 8 cycles. Each cycle shall have a 2 h minimum dwell at the high and at the low temperature levels. The transitions between low and high temperatures shall be at the maximum predicted thermal transient for the components, but not less than 3^o C per min.

6. A thermal cycle begins with the components at ambient temperature.

c. Procedure. **NOTE:** Steps 1 through 9 represent one thermal cycle.

1. With the component operating (power ON) and while critical parameters are being continuously monitored, reduce the chamber temperature to the specified low temperature level as measured at a representative location on the component, such as the mounting point on the baseplate for conduction-dominated internal designs or a representative location on the case for radiation-controlled designs.

2. After the component temperature has stabilized at less than 3^{o}C per h rate of change, turn the unit off, permit the component to soak for one-half the specified dwell time, and then cold start it.

3. Continue the soak time for one-half the specified dwell time period.

4. Perform the functional test as specified in the *Conditions* section.

5. With the component operating, and while critical parameters are being continuously monitored, increase the chamber temperature to the upper temperature level.

6. After the component temperature has stabilized at the specified level, turn the component off, permit the component to soak for one-half the specified dwell time period, and then hot start it.

7. Continue the soak time for one-half the specified dwell time period.

8. Perform the functional test as specified in the *Conditions* section.

9. The temperature of the chamber shall then be reduced to ambient conditions.

d. Pass/Fail Criteria. The test component shall be capable of meeting the requirements of the applicable specification*(s)* without any physical damage or degradation in performance.

4B1.4.1.8 Thermal Vacuum

a. Purpose. To demonstrate the ability of the component to perform in a thermal vacuum environment that simulates the design environment for the component.

b. Conditions

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1. Full functional tests shall be conducted at the high and low temperature levels during the first and last cycle and after return of the component to ambient temperature.

2. During the remainder of the test, electrical and electronic components, including all redundant circuits and paths, shall be monitored for failures and intermittents to the maximum extent possible.

3. Monitoring of the RF output for corona shall be conducted using spectrum monitoring instrumentation during chamber pressure reduction.

4. The RF component shall be operated at maximum power and at design frequency.

5. The force or torque design margin shall be measured on moving mechanical assemblies at the environmental extremes.

6. The component shall be mounted in a vacuum chamber on a thermally controlled heat sink or in the actual flight configuration when installed in the launch vehicle.

7. A temperature sensor shall be attached to the component baseplate for conduction-dominated internal designs or to a representative case locations for a component cooled primarily by radiation. **NOTE**: This sensor shall be used to determine and control the test temperature.

8. Components shall be operating during the initial reduction of pressure to the specified lowest pressure levels.

9. Components shall be monitored for arcing and corona during the initial reduction of pressure to the specified lowest pressure levels. **NOTE**: These components may be turned off after the test pressure level has been reached. With the chamber at the test pressure level, RF equipment shall be monitored to assure that corona does not occur.

10. The time for reduction of chamber pressure from ambient to 20 Pascals (0.15 Torr) shall be at least 10 min to allow sufficient time in the region of critical pressure.

11. A minimum of 3 temperature cycles shall be used.

12. Each cycle shall have a 12 h or longer dwell at the high and at the low temperature levels during which time the unit is turned off until the temperature stabilizes and then is turned on.

13. The component temperature shall be at the maximum flight predicted high temperature plus 10°C or 71°C, whichever is higher during the hot cycle and at the maximum flight predicted low temperature minus 10°C or -34°C, whichever is lower during the cold cycle. **NOTE:** A temperature cycle begins with the chamber at ambient temperature.

c. Procedure

1. With the component in the thermal chamber, reduce the pressure from atmospheric to a critical pressure (pressure at which a corona or arcing is likely to occur). A function test shall be performed.

2. Reduce the pressure from critical pressure to a minimum of 0.0133 Pascals (0.0001 Torr) or actual flight altitude, whichever is less. **NOTE:** Steps 3 through 6 constitute one complete temperature cycle.

3. With the component operating, reduce and stabilize the component temperature to the specified low level.

4. After the component temperature has stabilized at the specified level and all electrical circuits have been discharged, turn the component off then cold-start it.

5. With the component operating, increase the component temperature to the upper temperature level.

6. After the component temperature has stabilized at the specified level and all electrical circuits have been discharged, turn the component off and then hot-start it. **NOTE:** Temperature stability has been achieved when the rate of change is no more than 3°C per h. The component heat transfer to the thermally controlled heat sink and the radiation heat transfer to the environment shall be controlled to the same proportions as calculated for the flight environment.

7. Reduce the temperature of the chamber to ambient conditions.

d. Pass/Fail Criteria. The test component shall be capable of meeting the requirements of the applicable specification*(s)* without any physical damage or degradation in performance.

4B1.4.1.9 EMI/EMC

a. Purpose. To determine if the test component can continue to operate under an electromagnetic environment.

b. Procedure. Test the component to the require-

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ments of MIL-STD-461 or equivalent. The RF level shall be a the maximum expected or the default level of MIL-STD-461, whichever is greater.

4B1.4.1.10 Explosive Atmosphere

a. Purpose. To determine the ability of the test component to operate in the presence of an explosive atmosphere without creating an explosion

b. Condition. When being laboratory tested, the component shall operate in the presence of the optimum fuel vapor laden environment that requires the least amount of energy for ignition.

c. Procedure. A test method selected from an appropriate Military Standard or equivalent document is acceptable.

d. Pass/Fail Criteria. The test component shall be capable of meeting the requirements of the applicable specification*(s)* without any physical damage or degradation in performance.

4B1.4.1.11 Disassembly

a. Purpose. To inspect the component internal parts for excessive wear and damage after exposure to qualification level environments

b. Conditions

1. Components that require disassembly shall be completely taken apart to the point at which all internal parts can be inspected.

2. All internal components and subassemblies such as circuit board traces, internal connectors, screws, clamps, electronic piece parts, and mechanical subassemblies shall be examined using an appropriate inspection method (magnifying lens, radiographic).

3. The type of inspection that is required and the pass/fail criteria shall be included in the qualification test plan.

4. Components such as antennas, potted units, and welded structures that cannot be disassembled due to manufacturing techniques will be required to meet special inspection criteria. This may include depotting units, cutting components into cross-sections or radiographic inspection.

c. Pass/Fail Criteria. A component that exhibits any sign that an internal part is stressed beyond its design limit (cracked circuit boards, loose connectors/screws, bent clamps/screws, worn parts) is considered a failure of the component under test even if the component passes the final functional test.

4B1.4.2 Acceptance Tests

4B1.4.2.1 Random Vibration

a. Purpose. To detect material and workman-ship defects prior to acceptance of the component for flight

b. Conditions

1. A full functional test shall be conducted before and after the completion of the random vibration test.

2. During the random vibration test, electrical and electronic components, including redundant circuits, shall be electrically energized and functionally sequenced through various operational modes to the maximum extent possible.

3. Critical parameters as agreed to by Range Safety shall be continuously monitored for failures or intermittents during the random vibration test.

4. Where insufficient time is available at the full test level to test all functions and modes, extended testing at a level 6 dB lower shall be conducted as necessary to complete functional testing.

c. Procedure

1. Vibrate the component in each of 3 orthogonal axes.

2. The vibration test duration in each of the 3 orthogonal axes shall equal or exceed the expected flight exposure time, but shall not be less than 1 min per axis.

3. For hard mounted components, the minimum vibration test level shall be the MPE; however, the PSD shall not fall below that shown in Table 4B1-2.

Table 4B1-2
Minimum Power Spectral Density
For Acceptance Random Vibration

Frequency Range	Minimum PSD
20	0.0053 g^2/Hz
20-150	3 dB/OCTAVE SLOPE
150-600	0.04 g^2/Hz
600-2000	-6 dB/OCTAVE SLOPE
2000	0.0036 g^2/Hz
Overall GRMS = 6.1	

4. For isolated mounted components, the com-

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ponent shall be vibrated in a hard mounted mode and the PSD used shall be Curve C as defined in the **Random Vibration Qualification** section of this Appendix.

d. Pass/Fail Criteria. The test component shall be capable of meeting the requirements of the applicable specification*(s)* without any physical damage or degradation in performance.

4B1.4.2.2 Acoustic

a. Purpose. To detect material and workmanship defects prior to acceptance of the component for flight.

b. Conditions

1. A full functional test shall be conducted before and after the completion of the acoustic vibration test.

2. During the acoustic vibration test, electrical and electronic components, including redundant circuits, shall be electrically energized and functionally sequenced through various operational modes to the maximum extent possible.

3. Critical parameters as agreed to by Range Safety shall be continuously monitored for failures or intermittents during the acoustic vibration test.

4. The component shall be installed in a reverberant acoustic cell capable of generating desired sound pressure level.

5. The acoustic spectrum shall represent the maximum predicted flight environment.

6. The overall sound pressure level for acceptance testing shall not be less than 138 dBA.

7. The exposure time at full acceptance test level shall be equal to or exceed the maximum expected flight exposure time, but shall not be less than 1 min.

8. Where sufficient time is not available at the full test level to test all functions and modes, extended testing at a level 6 dB lower shall be conducted as necessary to complete functional testing.

c. Pass/Fail Criteria. The test component shall be capable of meeting the requirements of the applicable specification*(s)* without any physical damage or degradation in performance.

4B1.4.2.3 Acceleration

a. Purpose. To detect material and workmanship defects prior to acceptance of the component for flight.

b. Conditions

1. A full functional test shall be conducted before the acceleration test and after completion of the test.

2. Electrical components shall be powered during the test and critical parameters continuously monitored for failures or intermittents.

3. The test acceleration level shall be at the maximum predicted levels or 10 g, whichever is greater, in each direction for each of the 3 orthogonal axes.

4. The duration of the test shall be 3 min. per each axis in each direction.

c. Pass/Fail Criteria. The test component shall be capable of meeting the requirements of the applicable specification*(s)* without any physical damage or degradation of performance.

4B1.4.2.4 Thermal Cycle

a. Purpose. To detect material and workmanship defects prior to acceptance of the component for flight.

b. Conditions

1. Full functional tests shall be conducted during the 1, 2, 7, and 8 thermal cycles at high and low temperatures and after return of the component to ambient.

(a) The functional test at the 1 and 7 cycle shall be performed at high voltage input.

(b) The functional test at the 2 and 8 cycle shall be performed at low voltage input.

2. During the remainder of the test, electrical components, including all redundant circuits, shall be cycled through various operational modes and critical parameters monitored for failures and intermittents. These tests shall be performed at the nominal voltage input.

3. Pressure

(a) Ambient pressure shall normally be used unless testing is performed to the requirements of paragraph *3(c)* below.

(b) When unsealed components are being tested, the chamber may be flooded with dry air or nitrogen to preclude condensation on and within the component at low temperature.

(c) This test may be performed in a thermal vacuum and combined with the thermal vacuum tests, provided that the temperature limits, number

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of cycles, rate of temperature change, and dwell times conform to this test.

4. Duration

(a) A minimum of 8 cycles shall be performed.

(b) Each cycle shall have a 1 h minimum dwell at the high and at the low temperature levels during which the unit shall be turned off until the temperature stabilizes and then turned on. The dwell time at the high and low levels shall be long enough to obtain internal thermal equilibrium. The transitions between low and high temperatures shall be at an average rate of at least 1°C per min.

5. A thermal cycle begins with the component at ambient temperature.

6. The high temperature shall be the maximum predicted but not less than 61°C and the low temperature shall be the minimum predicted but not higher than -24°C.

c. Procedure. **NOTE:** Steps 1 through 9 represent one thermal cycle.

1. With the component operating (power ON) and while critical parameters are being continuously monitored, reduce the chamber temperature to the specified low temperature level as measured at a representative location on the component, such as the mounting point on the baseplate for conduction-dominated internal designs or a representative location on the case for radiation-controlled designs.

2. After the component temperature has stabiized at less than 3°C per h rate of change, turn the unit off, permit the component to soak for one-half the specified dwell time, and then cold start it.

3. Continue the soak time for one-half the specified dwell time period.

4. Perform the functional test as specified in the *CONDITIONS* section.

5. With the component operating, and while critical parameters are being continuously monitored, increase the chamber temperature to the upper temperature level.

6. After the component temperature has stabilized at the specified level, turn the component off, permit the component to soak for one-half the specified dwell time period, and then hot start it.

7. Continue the soak time for one-half the specified dwell time period.

8. Perform the functional test as specified in the *Conditions* section.

9. The temperature of the chamber shall then be reduced to ambient conditions.

d. Pass/Fail Criteria. The test component shall be capable of meeting the requirements of the applicable specification*(s)* without any physical damage or degradation in performance.

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4B1.4.2.5 Thermal Vacuum

a. Purpose. To detect material and workmanship defects prior to acceptance of the component for flight.

b. Conditions

1. Full functional tests shall be conducted at the high and low temperature levels and after return of the component to ambient temperature.

2. Monitoring of the RF output for corona shall be conducted using spectrum monitoring instrumentation during chamber pressure reduction.

3. The RF component shall be operated at maximum power and at design frequency.

4. The force or torque design margin shall be measured on moving mechanical assemblies at the environmental extremes.

5. The component shall be mounted in a vacuum chamber on a thermally controlled heat sink or in the actual flight configuration when installed in the launch vehicle.

6. A temperature sensor shall be attached to the component baseplate for conduction-dominated internal designs or to a representative case locations for a component cooled primarily by radiation. **NOTE**: This sensor shall be used to determine and control the test temperature.

7. Components shall be operating during the initial reduction of pressure to the specified lowest pressure levels.

8. Components shall be monitored for arcing and corona during the initial reduction of pressure to the specified lowest pressure levels. **NOTE**: These components may be turned off after the test pressure level has been reached. With the chamber at the test pressure level, RF equipment shall be monitored to assure that corona does not occur.

9. The time for reduction of chamber pressure from ambient to 20 Pascals (0.15 Torr) shall be at least 10 min to allow sufficient time in the region of critical pressure.

10. The component temperature shall be at the maximum flight predicted high temperature or 61^{o}C, whichever is higher, during the hot cycle and at the maximum flight predicted low temperature or -24^{o}C, whichever is lower, during the cold cycle.

11. A minimum of one temperature cycle shall be used.

12. Each temperature cycle shall have a 12 h or longer dwell at the high and at the low temperature levels during which time the unit is turned off until the temperature stabilizes and then is turned on.

c. Procedure

1. With the component in the thermal chamber, reduce the pressure from atmospheric to a critical pressure (pressure at which a corona or arcing is likely to occur). A function test shall be performed.

2. Reduce the pressure from critical pressure to a minimum of 0.0133 Pascals (0.0001 Torr) or actual flight altitude, whichever is less. **NOTE:** Steps 3 through 6 constitute one complete temperature cycle.

3. With the component operating, reduce and stabilize the component temperature to the specified low level.

4. After the component temperature has stabilized at the specified level and all electrical circuits have been discharged, turn the component off and then cold-start it.

5. Increase the component temperature to the upper temperature level.

6. After the component temperature has stabilized at the specified level and all electrical circuits have been discharged, turn the component off and then hot-start it. **NOTE:** Temperature stability has been achieved when the rate of change is no more than 3^{o}C per h. The component heat transfer to the thermally controlled heat sink and the radiation heat transfer to the environment shall be controlled to the same proportions as calculated for the flight environment.

6. Reduce the temperature of the chamber to ambient conditions.

d. Pass/Fail Criteria. The test component shall be capable of meeting the requirements of the applicable specification*(s)* without any physical damage or degradation in performance.

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4B1.4.2.6 Burn-In

a. Purpose. To detect material and workmanship defects that occur early in component life.

b. Conditions

1. A modified thermal cycling test shall be used to accumulate the additional operational hours that are required for the burn-in test of electronic and electrical components.

2. The transitions between low and high temperatures shall be at an average rate greater than 1°C per min.

3. The high temperature shall be the maximum predicted but not less than +61°C, and the low temperature shall be the minimum predicted but not higher than -24°C.

4. The total operating time for component burn-in shall be 300 h including the operating time during thermal cycle.

5. The minimum number of temperature cycles shall be 18 including those conducted during the thermal cycling acceptance test.

6. Additional test time beyond the time that is required for thermal cycling shall be conducted at either the maximum or the minimum temperature.

c. Procedure

1. While the component is operating (power ON) and all of the critical parameters are being monitored, reduce the temperature of the component to the specified low temperature level.

2. Operate the component at the low temperature level for a minimum of 1 h.

3. Increase the component temperature to the specified high temperature level and continue to operate the component at this temperature for a minimum of 1 h.

4. To complete one cycle of the burn-in test, reduce the component temperature to ambient temperature.

APPENDIX 4B2
ANTENNA SYSTEM TEST REQUIREMENTS

Table 4B2-1
Antenna System Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Product Examination		
Visual	4B1.2.1	100%
Weight	4B1.2.2	100%
Dimension	4B1.2.3	100%
Identification	4B1.2.4	100%
Functional Tests *(a)*		
Grounding	4B2.1	100%
Impedance/VSWR	4B2.2	100%
Insertion Loss	4B2.4	100%
RF Isolation	4B2.5	100%
Reference Functional Test *(b)*		
Impedance/VSWR	4B2.2	100%
Operating Environment Tests		
Acoustic	4B1.4.2.2	100%
Acceleration	4B1.4.2.3	100%
Thermal Cycling	4B1.4.2.4	100%
Thermal Vacuum	4B1.4.2.5	100%
Random Vibration	4B1.4.2.1	100%
Leakage *(c)*	4B1.2.7	100%

(a) These tests shall be performed prior to and after each environmental test.
(b) This test shall be performed during the operating environment tests.
(c) This test shall be performed after the last operating environment test.

APPENDIX 4B2
ANTENNA SYSTEM TEST REQUIREMENTS

Table 4B2-2
Antenna System Qualification Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		1	1	1
Acceptance	ACCEPTANCE TEST MATRIX	X	X	X
Antenna Patterns *(a)*	4B2.6	X	X	X
Functional Tests *(b)*				
Grounding	4B2.1	X	X	X
Impedance/VSWR	4B2.2	X	X	X
Polarization	4B2.3	X	X	X
Insertion loss	4B2.4	X	X	X
RF Isolation	4B2.5	X	X	X
Reference Functional Test *(c)*				
Impedance/VSWR	4B2.2	X	X	X
Non-Operating Environment Tests				
Storage Temperature	4B1.3.1	X	X	X
Transport Shock/Bench Handling	4B1.3.3	X	X	X
Transportation Vibration	4B1.3.4	X	X	X
Fungus Resistance	4B1.3.5	X		
Salt Fog	4B1.3.6		X	
Fine Sand	4B1.3.7			X
Operating Environment Tests				
Sinusoidal Vibration	4B1.4.1.1	X	X	X
Acoustic	4B1.4.1.3	X	X	X
Shock	4B1.4.1.4	X	X	X
Acceleration	4B1.4.1.5	X	X	X
Humidity	4B1.4.1.6			X
Thermal Cycling	4B1.4.1.7	X	X	X
Thermal Vacuum	4B1.4.1.8	X	X	X
Random Vibration	4B1.4.1.2	X	X	X
EMI/EMC	4B1.4.1.9			X
Leakage *(d)*	4B1.2.7	X	X	X
Disassembly	4B1.4.1.11	X	X	X

(a) This test shall only be performed prior to environmental testing and after all environmental testing has been completed.
(b) These tests shall be performed prior to and after each environmental test.
(c) This test shall be performed during the operating environment tests.
(d) This test shall be performed after the last non-operating and the last operating environment tests.

APPENDIX 4B2
ANTENNA SYSTEM TEST REQUIREMENTS

4B2.1 Grounding

Measure all external conductive parts of the antenna system to verify that they are at ground potential in accordance with the component specification.

4B2.2 Impedance and VSWR

Measure the impedance and VSWR at the assigned operating frequency and at the maximum and the minimum frequencies of the operational bandwidth.

4B2.3 Polarization

Perform test to demonstrate the component compatibility with the on-axis, left-hand circular polarization.

4B2.4 Insertion Loss

Measure the antenna system insertion loss.

4B2.5 RF Isolation (Couplers only)

Measure the isolation between the RF junction ports.

4B2.6 Antenna Patterns

a. Perform antenna pattern measurements in accordance with RCC Document 253.

b. Compare the pre-qualification test pattern data to the post-qualification test pattern to determine if a significant change has occurred in the antenna radiation pattern. **NOTE**: A significant change is defined as more than 3 dB change over the 95 percent spherical coverage.

APPENDIX 4B3
COMMAND RECEIVER/DECODER TEST REQUIREMENTS

Table 4B3-1
Standard Command Receiver/Decoder Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Product Examination		
Visual	4B1.2.1	100%
Weight	4B1.2.2	100%
Dimension	4B1.2.3	100%
Identification	4B1.2.4	100%
Full Functional Tests *(a)*		
Resistances *(b)*	4B3.1	100%
DC Input Voltage	4B3.2	100%
Input Current	4B3.3	100%
Self-Test	4B3.4	100%
Leakage Current	4B3.6	100%
Input Impedance/VSWR	4B3.7	100%
RF Threshold Sensitivity	4B3.8	100%
Output Functions	4B3.9	100%
Maximum Usable RF Level	4B3.10	100%
RF Level Monitor (SSTO)	4B3.11	100%
CW Bandwidth	4B3.13	100%
Operational Bandwidth	4B3.15	100%
CW Peak-To-Valley Ratio	4B3.15	100%
Decoder Channel Bandwidth	4B3.16	100%
Decoder Channel Deviation	4B3.17	100%
Capture Ratio	4B3.21	100%
AM Rejection 50%	4B3.22	100%
Response Time	4B3.23	100%
Output Load Characteristic	4B3.25	100%
Decoder Logic	4B3.46	100%
Reference Functional Tests *(c)*		
Input Current Monitor	4B3.43	100%
Output Functions	4B3.9	100%
RF Level Monitor (SSTO)	4B3.11	100%
Operating Environment Tests		
Acoustic	4B1.4.2.2	100%
Acceleration	4B1.4.2.3	100%
Thermal Cycling *(d)*	4B1.4.2.4	100%
Thermal Vacuum *(e)*	4B1.4.2.5	100%
Random Vibration	4B1.4.2.1	100%
Burn-In	4B1.4.2.6	100%
Leakage *(f)*	4B1.2.7	100%

(a) These tests shall be performed prior to and after each environmental test.
(b) This test shall be performed prior to and after all environmental tests have been completed.
(c) These tests shall be performed during the operating environment tests.
(d) The full functional tests, except test 4B3.1, 2, 3, 4, 6, and 7, shall be performed at high voltage input on the 1 and 7 cycles, low voltage input on the 2 and 8 cycles, and reference functional tests for the remaining cycles at nominal voltage input.
(e) The full functional test, except test 4B3.1, 2, 3, 4, 6, and 7, shall be performed during the high and low temperature soak periods.
(f) This test shall be performed after the last operating environment test.

APPENDIX 4B3
COMMAND RECEIVER/DECODER TEST REQUIREMENTS

Table 4B3-2
Standard Command Receiver/Decoder Qualification Test Matrix
(Page 1 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		1	1	1
Acceptance	ACCEPTANCE TEST MATRIX	X	X	X
Circuit Protection Tests *(a)*				
Reverse Polarity Protection	4B3.5	X	X	X
Telemetry Short Circuit	4B3.32	X	X	X
Output Circuit Protection	4B3.33	X	X	X
Abnormal Voltage	4B3.34	X	X	X
Over Voltage Protection	4B3.45	X	X	X
Functional Tests *(b)*				
Resistances *(c)*	4B3.1	X	X	X
DC Input Voltage	4B3.2	X	X	X
Input Current	4B3.3	X	X	X
Self-Test	4B3.4	X	X	X
Leakage Current	4B3.6	X	X	X
Input Impedance/VSWR	4B3.7	X	X	X
RF Threshold Sensitivity	4B3.8	X	X	X
Output Functions	4B3.9	X	X	X
Maximum Usable RF Level	4B3.10	X	X	X
RF Level Monitor (SSTO)	4B3.11	X	X	X
CW Bandwidth	4B3.13	X	X	X
Operational Bandwidth	4B3.15	X	X	X
CW Peak-To-Valley Ratio	4B3.15	X	X	X
Decoder Channel Bandwidth	4B3.16	X	X	X
Decoder Channel Deviation	4B3.17	X	X	X
Adjacent Channel Rejection	4B3.19	X	X	X
Spurious Response Rejection	4B3.20	X	X	X
Capture Ratio	4B3.21	X	X	X
AM Rejection 50% & 100%	4B3.22	X	X	X
Response Time	4B3.23	X	X	X
Output Load Characteristics	4B3.25	X	X	X
Image Rejection	4B3.26	X	X	X
Warm-up Time	4B3.27	X	X	X
Dynamic Stability	4B3.28	X	X	X
Out-Of-Band Rejection	4B3.29	X	X	X
Noise Immunity	4B3.30	X	X	X
Decoder Logic	4B3.46	X	X	X

(a) One time test.
(b) These tests shall be performed prior to and after each environmental test.
(c) This test shall be performed prior to and after all environmental tests have been completed.

APPENDIX 4B3
COMMAND RECEIVER/DECODER TEST REQUIREMENTS

Table 4B3-2, Continued
Standard Command Receiver/Decoder Qualification Test Matrix
(Page 2 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		1	1	1
Reference Functional Tests *(d)*				
Input Current Monitor	4B3.43	X	X	X
Output Functions	4B3.9	X	X	X
RF Level Monitor (SSTO)	4B3.11	X	X	X
Non-Operating Environment Tests				
Storage Temperature	4B1.3.1	X	X	X
Transport Shock/Bench Handling	4B1.3.3	X	X	X
Transportation Vibration	4B1.3.4	X	X	X
Fungus Resistance	4B1.3.5	X		
Salt Fog	4B1.3.6	X		
Fine Sand	4B1.3.7		X	
Operating Environment Tests				
Sinusoidal Vibration	4B1.4.1.1	X	X	X
Acoustic	4B1.4.1.3	X	X	X
Shock	4B1.4.1.4	X	X	X
Acceleration	4B1.4.1.5	X	X	X
Humidity	4B1.4.1.6			X
Thermal Cycling *(e)*	4B1.4.1.7	X	X	X
Thermal Vacuum *(f)*	4B1.4.1.8	X	X	X
Random Vibration	4B1.4.1.2	X	X	X
EMI/EMC	4B3.44		X	X
Explosive Atmosphere	4B1.4.1.10	X		
Leakage *(g)*	4B1.2.7	X	X	X
Disassembly	4B1.4.1.11	X	X	X

(d) These tests shall be performed during the operating environment tests.

(e) The full functional tests, except 4B3.1, 2, 3, 4, 6, 7, 36, 37, 38, and 42, shall be performed at high voltage input on the 1 and 23 cycles, nominal voltage on the 12 and 13 cycles, low voltage input on the 2 and 24 cycles, and reference functional tests for the remaining cycles at nominal voltage input.

(f) The full functional tests, except 4B3.1, 2, 3, 4, 6, 7, 36, 37, 38, and 42, shall be performed at high and low temperature soak period of first and last cycle.

(g) This test shall be performed after the last non-operating and the last operating environment tests.

APPENDIX 4B3
COMMAND RECEIVER/DECODER TEST REQUIREMENTS

Table 4B3-3
Secure Command Receiver/Decoder Acceptance Test Matrix
(Page 1 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED
Product Examination		
Visual	4B1.2.1	100%
Weight	4B1.2.2	100%
Dimension	4B1.2.3	100%
Identification	4B1.2.4	100%
Full Functional Tests *(a)*		
Resistances *(b)*	4B3.1	100%
DC Input Voltage	4B3.2	100%
Input Current	4B3.3	100%
Self-Test	4B3.4	100%
Leakage Current	4B3.6	100%
Input Impedance/VSWR	4B3.7	100%
RF Threshold Sensitivity	4B3.8	100%
Output Functions	4B3.9	100%
Maximum Usable RF Level	4B3.10	100%
RF Level Monitor (SSTO)	4B3.11	100%
CW Bandwidth	4B3.13	100%
Operational Bandwidth	4B3.15	100%
CW Peak-To-Valley Ratio	4B3.15	100%
Decoder Channel Bandwidth	4B3.16	100%
Decoder Channel Deviation	4B3.17	100%
Capture Ratio	4B3.21	100%
AM Rejection 50% (Pilot Tone)	4B3.22	100%
Response Time	4B3.23	100%
Output Load Characteristic	4B3.25	100%
Destruct Before Arm	4B3.39	100%
Reset	4B3.41	100%

(a) These tests shall be performed prior to and after each environmental test.
(b) This test shall be performed prior to and after all environmental tests have been completed.

APPENDIX 4B3
COMMAND RECEIVER/DECODER TEST REQUIREMENTS

Table 4B3-3, Continued
Secure Command Receiver/Decoder Acceptance Test Matrix
(Page 2 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED
Reference Functional Tests *(c)*		
Input Current Monitor	4B3.43	100%
Output Functions	4B3.9	100%
RF Level Monitor (SSTO)	4B3.11	100%
Operating Environment Tests		
Acoustic	4B1.4.2.2	100%
Acceleration	4B1.4.2.3	100%
Thermal Cycling *(d)*	4B1.4.2.4	100%
Thermal Vacuum *(e)*	4B1.4.2.5	100%
Random Vibration	4B1.4.2.1	100%
Burn-In	4B1.4.2.6	100%
Leakage *(f)*	4B1.2.7	100%

(c) These tests shall be performed during the operating environment tests.
(d) The full functional tests, except test 4B3.1, 2, 3, 4, 6, and 7, shall be performed at high voltage input on the 1 and 7 cycles, low voltage input on the 2 and 8 cycles, and reference functional tests for the remaining cycles at nominal voltage input.
(e) The full functional test, except test 4B3.1, 2, 3, 4, 6, and 7, shall be performed during the high and low temperature soak periods.
(f) This test shall be performed after the last operating environment test.

APPENDIX 4B3
COMMAND RECEIVER/DECODER TEST REQUIREMENTS

Table 4B3-4
Secure Command Receiver/Decoder Qualification Test Matrix
(Page 1 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		1	1	1
Acceptance	ACCEPTANCE TEST MATRIX	X	X	X
Circuit Protection Tests *(a)*				
Reverse Polarity Protection	4B3.5	X	X	X
Telemetry Short Circuit	4B3.32	X	X	X
Output Circuit Protection	4B3.33	X	X	X
Abnormal Voltage	4B3.34	X	X	X
Over Voltage Protection	4B3.45	X	X	X
Functional Tests *(b)*				
Resistances *(c)*	4B3.1	X	X	X
DC Input Voltage	4B3.2	X	X	X
Input Current	4B3.3	X	X	X
Self-Test	4B3.4	X	X	X
Leakage Current	4B3.6	X	X	X
Input Impedance/VSWR	4B3.7	X	X	X
RF Threshold Sensitivity	4B3.8	X	X	X
Output Functions	4B3.9	X	X	X
Maximum Usable RF Level	4B3.10	X	X	X
RF Level Monitor (SSTO)	4B3.11	X	X	X
CW Bandwidth	4B3.13	X	X	X
Operational Bandwidth	4B3.15	X	X	X
CW Peak-To-Valley Ratio	4B3.15	X	X	X
Decoder Channel Bandwidth	4B3.16	X	X	X
Decoder Channel Deviation	4B3.17	X	X	X
Spurious Response Rejection	4B3.20	X	X	X
Capture Ratio	4B3.21	X	X	X
AM Rejection 50% & 100% (Pilot Tone)	4B3.22	X	X	X
	4B3.23	X	X	X
Response Time	4B3.25	X	X	X
Output Load Characteristics	4B3.26	X	X	X
Image Rejection	4B3.27	X	X	X
Warm-up Time	4B3.28	X	X	X
Dynamic Stability	4B3.29	X	X	X
Out-Of-Band Rejection				

(a) One time test.
(b) These tests shall be performed prior to and after each environmental test.
(c) This test shall be performed prior to and after all environmental tests have been completed.

APPENDIX 4B3
COMMAND RECEIVER/DECODER TEST REQUIREMENTS

Table 4B3-4, Continued
Secure Command Receiver/Decoder Qualification Test Matrix
(Page 2 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		1	1	1
Functional Tests *(b)* (continued):				
Tone Drop *(a)*	4B3.36	X	X	X
Tone Balance *(a)*	4B3.37	X	X	X
Message Timing *(a)*	4B3.38	X	X	X
Destruct Before Arm	4B3.39	X	X	X
Secure Logic	4B3.40	X	X	X
Reset	4B3.41	X	X	X
Memory *(a)*	4B3.42	X	X	X
Reference Functional Tests *(d)*				
Input Current Monitor	4B3.43	X	X	X
Output Functions	4B3.9	X	X	X
RF Level Monitor (SSTO)	4B3.11	X	X	X
Non-Operating Environment Tests				
Storage Temperature	4B1.3.1	X	X	X
Transport Shock/Bench Handling	4B1.3.3	X	X	X
Transportation Vibration	4B1.3.4	X	X	X
Fungus Resistance	4B1.3.5	X		
Salt Fog	4B1.3.6	X		
Fine Sand	4B1.3.7		X	
Operating Environment Tests				
Sinusoidal Vibration	4B1.4.1.1	X	X	X
Acoustic	4B1.4.1.3	X	X	X
Shock	4B1.4.1.4	X	X	X
Acceleration	4B1.4.1.5	X	X	X
Humidity	4B1.4.1.6			X
Thermal Cycling *(e)*	4B1.4.1.7	X	X	X
Thermal Vacuum *(f)*	4B1.4.1.8	X	X	X
Random Vibration	4B1.4.1.2	X	X	X
EMI/EMC	4B3.44		X	X
Explosive Atmosphere	4B1.4.1.10	X		
Leakage *(g)*	4B1.2.7	X	X	X
Disassembly	4B1.4.1.11	X	X	X

(a) One time test.
(b) These tests shall be performed prior to and after each environmental test.
(c) This test shall be performed prior to and after all environmental tests have been completed.
(d) These tests shall be performed during the operating environment tests.
(e) The full functional tests, except 4B3.1, 2, 3, 4, 6, 7, 36, 37, 38, and 42, shall be performed at high voltage input on the 1 and 23 cycles, nominal voltage on the 12 and 13 cycles, low voltage input on the 2 and 24 cycles, and reference functional tests for the remaining cycles at nominal voltage input.
(f) The full functional tests, except 4B3.1, 2, 3, 4, 6, 7, 36, 37, 38, and 42, shall be performed at high and low temperature soak period of first and last cycle.
(g) This test shall be performed after the last non-operating and the last operating environment tests.
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APPENDIX 4B3
COMMAND RECEIVER/DECODER TEST REQUIREMENTS

NOTE: RCC 313 can be used to supplement test methodology.

4B3.1 Resistances

a. Verify that the CRD isolation and grounding resistance between the case ground and all power leads, signal outputs and command outputs, including returns, and between power leads and signal leads, including returns are within the requirements that are specified in the applicable component specification.

b. Measure all conductive external parts of the component to verify that they are at case ground potential.

4B3.2 DC Input Voltage

a. During this test, vary the DC power supply from the specified minimum to the maximum.

b. Verify that CRD power consumption is within the specified limits.

c. Verify that the CRD functions normally at all voltage requirements as specified by the applicable specification.

4B3.3 Input Current

a. Measure the maximum current in the standby mode at the low, nominal, and high supply voltage.

b. Measure the maximum current in the commanded mode (under loaded conditions) at the low, nominal, and high supply voltages.

4B3.4 Self-Test

a. Purpose. This test is applicable only to those CRDs that have microprocessors.

b. Procedure

1. Verify that the CRD microprocessor is capable of processing a test command routine and that it will issue a pass/fail output.

2. Verify that the CRD will not inhibit a command or cause a change state during a self-test routine.

4B3.5 Reverse Polarity Protection

Verify that the CRD will not be damaged, have a permanent deterioration of performance, or issue an outputting command when it is subjected to the reversal of the input voltage for a period of 5 min.

4B3.6 Leakage Current

Verify that the output leakage current (with no RF applied) does not exceed the value that is specified in the applicable specification.

4B3.7 Input Impedance and Voltage Standing Wave Ratio (VSWR)

Verify that the CRD input impedance is 50 ohms and that the VSWR is not greater than 2:1 across the specified bandwidth of the specified operating frequency.

4B3.8 RF Threshold Sensitivity

Verify the minimum RF signal input level at which the CRD correctly activates all command channels. **NOTE**: The threshold sensitivity shall be as specified in the procurement specification but shall be between -107 dBm to -116 dBm.

4B3.9 Output Functions

Verify that the CRD responds to all input tone combinations at the minimum specified RF threshold level.

4B3.10 Maximum Usable RF Operating Level

Verify that the CRD will generate the correct output functions when it is subjected to variations of the RF signal input signal level up to a maximum of +13 dBm. **NOTE**: At a minimum, the following 5 RF input levels shall be used: +13 dBm (1 Vrms), -7 dBm (100,000 microvolts RMS [uVrms]), -27 dBm (10,000 uVrms), -67 dBm (100 uVrms) and the specified threshold sensitivity.

4B3.11 RF Level Monitor

Verify that the signal strength telemetry output monitor voltage meets the following requirements when operating into a 10 kilohm load. **NOTE**: This output is also called "Signal Strength Telemetry Output (SSTO)," or "Automatic Gain Control (AGC)".

a. The SSTO output level quiescent (no RF signal) condition shall be 0.5 ±0.25 Vdc.

b. The SSTO measured command threshold sensitivity input condition shall be 0.1 Vdc minimum above the quiescent value.

APPENDIX 4B3
COMMAND RECEIVER/DECODER TEST REQUIREMENTS

c. The SSTO output level shall reach a maximum (4.75 ±0.25 Vdc) with no less than 500 microvolts (-53 dBm) of RF input.

d. The shape of the transfer function shall not exceed approximately 1.0 Vdc change in voltage for each 13 dB change in RF input signal over the range between threshold and saturation.

e. The maximum SSTO voltage shall not exceed 5 Vdc under all conditions.

f. The slope of the SSTO voltage shall not change polarity from measured threshold to +13 dBm. **NOTE:** The slope of the SSTO voltage is monotonic.

4B3.12 Intentionally Left Blank

4B3.13 Continuous Wave Bandwidth

Verify that the continuous wave (CW) IF bandwidth of the receiver is 180.0 kHz minimum at 3 dB points and 360.0 kHz maximum at the 60 dB points.

4B3.14 Intentionally Left Blank

4B3.15 Operational Bandwidth/CW Peak-To-Valley Ratio

a. Verify that the CRD will properly function at all of the commands within the bandwidth of ±45 kHz from the assigned RF center frequency with command input tone variations of plus and minus 27 kHz to plus and minus 33 kHz per tone. **NOTE**: The input RF level for this test shall be at the specified threshold sensitivity level.

b. Verify that the intermediate frequency (IF) filter is flat (within 3 dB) when it is subjected to an RF input signal (±45 kHz) that is centered at the assigned frequency.

4B3.16 Decoder Channel Bandwidth

Verify that the CRD decoder channel bandwidth that is required to generate a tone is within the limits that are specified in the applicable component specification. **NOTE 1:** During this test the RF input signal shall be at -47 dBm (1000 microvolts). **NOTE 2:** For secure CRDs: Only the pilot tone is required to be measured during Acceptance testing.

4B3.17 Decoder Channel Deviation

a. Verify that the CRD decoder operates normally with a deviation of plus and minus 27 to 33 kHz per tone and at a two tone deviation of plus and minus 54 to 66 kHz.

b. Test the CRD decoder to ensure that it does not produce a decoder output at deviation levels of plus or minus 9 kHz or less per tone.

c. Verify that the actual threshold deviation level at which the CRD first responds to commands is between plus and minus 9 kHz and plus and minus 18 kHz.

4B3.18 Intentionally Left Blank

4B3.19 Adjacent Tone Decoder Channel Rejection

Verify that the tone decoder channels do not respond to adjacent FM modulated tone channels when they are FM modulated with plus and minus 50 kHz per tone.

4B3.20 Spurious Response Rejection

Verify that any spurious response*(s)* that is within the frequency spectrum from 10 MHz to 1000 MHz (omitting the frequency band within the 60 dB bandwidth) is at least 60 dB minimum below the measured threshold sensitivity at center frequency.

4B3.21 Capture Ratio

Verify that the CRD will not be captured and/or interfered with when it is subjected to an unmodulated RF signal level up to 80 percent (-2 dB) of the desired modulated RF carrier signal at the same frequency.

4B3.22 AM Rejection 50 Percent and 100 Percent

Verify that the CRD can reject an AM modulated signal and that the CRD shall not produce an output from any decoder channel under the following conditions:

a. An RF input signal at the assigned center frequency of -90.1 dBm (7 microvolts) with 50 percent AM modulation by the assigned RCC tone frequencies

b. An RF input signal at the assigned frequency of -85.4 dBm (12 microvolts) signal with 50 percent AM modulation by the assigned RCC tone frequencies

c. An RF input signal at the assigned RF center frequency of -67 dBm (100 micro volts) with 100 percent peak AM noise modulation at Low Pass Filter (LPF) 3 dB frequencies of 3.5 kHz or 7.0

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COMMAND RECEIVER/DECODER TEST REQUIREMENTS

kHz.

4B3.23 Channel Response Time

Verify that the response time that is required for the CRD to activate the channel output when the tone*(s)* is applied, is within the specified time that is indicated in the component specification. **NOTE 1:** The RF input level for this test shall be -67 dBm. **NOTE 2:** The minimum/maximum activation time is specified in applicable specification sheet but shall not be less than 4 millisec nor greater than 25 millisec when tested at the specified threshold sensitivity.

4B3.24 Intentionally Left Blank

4B3.25 Output Load Characteristics

Verify that the CRD is capable of outputting the specified power to the specified load on each output at any CRD input power supply voltage level between the minimum and the maximum specified.

4B3.26 Image Rejection

Verify that the CRD RF selectivity can reject frequencies other than the first harmonic and subharmonic of the assigned center frequency by 60 dB minimum.

4B3.27 Warm Up Time

Verify that time that is required by the CRD to properly respond to a command, after DC power is applied, is within the applicable component specification.

4B3.28 Dynamic Stability

Verify that the CRD will not produce false commands or spurious outputs when it is subjected to a change in the input of VSWR and/or open and short circuit conditions of the RF input sources.

4B3.29 Out-of-Band Rejection

Verify that the CRD will not respond to RF signals that are out-of-band as stated in the applicable component specification.

4B3.30 Noise Immunity

Verify that the CRD will not produce a command output when it is subjected to an RF signal of -95 dBm that is FM modulated with white noise at an amplitude of at least 12 dB higher than the measured deviation threshold of any individual audio tone. The white noise spectrum shall be at least 0 to 600 kHz.

4B3.31 Intentionally Left Blank

4B3.32 Telemetry Short Circuit

Verify that the CRD can process an Arm and Destruct command while the telemetry outputs are short circuited.

4B3.33 Output Circuit Protection

Verify that the CRD shall not be damaged by the application of up to 45 Vdc or the open circuit voltage (OCV) of the power source, whichever is greater, to any of the output monitor ports for up to 5 min.

a. When the ARM and OPTIONAL output channels are used for vehicle functions such as engine shutdown, they shall also meet the requirement stated above.

b. The CRD shall meet the requirement stated above in the ON and OFF mode.

4B3.34 Abnormal Voltage

Verify that the CRD can be subjected to low voltage and not suffer damage.

a. While a proper command is applied to the CRD, slowly adjust the voltage from zero to nominal voltage and back to zero.

b. Record the DC levels where the CRD first outputs the command and then ceases to output the command.

4B3.35 Intentionally Left Blank

4B3.36 Tone Drop

Verify that the CRD will reject an otherwise valid command when one tone in the sequence has been dropped.

4B3.37 Tone Balance

Verify that the amount of tone pair imbalances, with the CRD continuing to process the command, is within the component specification.

4B3.38 Message Timing

Verify that the CRD message timing tolerances are within the component specification.

4B3.39 DESTRUCT Before ARM

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COMMAND RECEIVER/DECODER TEST REQUIREMENTS

Verify that the CRD will reject an otherwise valid DESTRUCT command if not preceded by a valid ARM command.

4B3.40 Secure Logic

Verify that the CRD will reject a message that has been altered by one tone number from a valid command.

4B3.41 Reset

Verify that the CRD will remove all outputs by DC power cycling (ON/OFF/ON) and by processing a valid secure reset command.

4B3.42 Memory

Verify that secure commands remain in memory for the specified time interval.

4B3.43 Input Current Monitor

Verify that the CRD current that is drawn during the standby and output command (ARM, DESTRUCT) mode is within the component specification.

4B3.44 EMI/EMC

a. Purpose. To determine if the test component can continue to operate under an electromagnetic environment.

b. Procedure. Test the component in accordance with the MIL-STD-462 procedure.

4B3.45 Overvoltage Protection

Verify that FTS components will meet the following overvoltage protection requirements:

a. FTS components shall not be damaged by the application of up to 45 Vdc or OCV of the power source, whichever is greater.

b. This voltage shall be applied in both normal and reverse polarity modes to the component power input ports for a period not less than 5 min.

c. The components shall not produce an output or be damaged.

4B3.46 Decoder Logic

At an RF level of -47 dBm, verify the CRD response to specified logics and ensure that it does not respond to abnormal logics per Table 4B3-5.

APPENDIX 4B3
COMMAND RECEIVER/DECODER TEST REQUIREMENTS

Table 4B3-5
Standard Logic Verification Test

TEST	SWITCH SEQUENCE	REQUIRED CRD OUTPUT	TONES ON
01	None	None	None
02	1 On	None	1
03	2 On	None	1, 2
04	5 On	ARM	1, 2, 5
05	5 Off	ARM and DESTRUCT	1, 2
06	2 Off	ARM	1
07	5 On	ARM	1, 5
08	2 On	ARM	1, 2, 5
09	2 Off	ARM	1, 5
10	5 Off	ARM	1
11	1 Off	None	None
12	2 On	None	2
13	1 On	None	1, 2
14	5 On	ARM	1, 2, 5
15	5 Off	ARM and DESTRUCT	1, 2
16	1 Off	None	2
17	5 Off	OPTIONAL	2, 5
18	1 On	ARM	1, 2, 5
19	1 Off	OPTIONAL	2, 5
20	5 Off	None	2
21	2 Off	None	None
22	5 On	None	5
23	1 On	ARM	1, 5
24	2 On	ARM	1, 2, 5
25	2 Off	ARM	1, 5
26	1 Off	None	5
27	2 On	OPTIONAL	2, 5
28	1 On	ARM	1, 2, 5
29	1 Off	OPTIONAL	2, 5
30	2 Off	None	5
31	5 Off	None	None
32	1 On	None	1
33	5 On	ARM	1, 5
34	2 On	ARM	1, 2, 5
35	5 Off	ARM and DESTRUCT	1, 2
36	2 Off	ARM	1
37	1 Off	None	None
38	1 On	None	1
39	5 On	ARM	1, 5
40	5 Off	ARM	1
41	2 On	ARM and DESTRUCT	1, 2
42	All Tones Off	None	None
43	4 On	CHECK CHANNEL	4
44	4 Off	None	None
45	4 On and repeat tests 01 through 44		

APPENDIX 4B4
BATTERY TEST REQUIREMENTS

Table 4B4-1
Silver Zinc Battery Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Product Examination		
Inspection	4B1.2.1	100%
Weight	4B1.2.2	100%
Dimensions	4B1.2.3	100%
Identification	4B1.2.4	100%
X-Ray	4B4.1.2	100%
Battery and Cell Venting	4B4.1.3	100%
Safety Devices	4B4.1.4	100% or Lot Sample *(a)*
Proof Pressure/Leak Test	4B4.1.5	100%
Electrolyte	4B4.1.6	100%
Electrical Tests		
Insulation Resistance	4B4.1.7	100%
Monitoring Devices	4B4.1.9	100%
Connector Pins Verification	4B4.1.10	100%
	4B4.1.11	100%
Heater Circuit Resistance	4B4.1.12	100%
Heater Circuit Operation	4B4.1.13	100%
Activation	4B4.1.14	100%
Leakage Current	4B4.1.15	100%
No-Load Voltage	4B4.1.16	100%
Load Test		
Verification Cell Acceptance Tests	4B4.1.1.5	1 Cell/Flight Battery
Discharge		
Cycling		

(a) If these tests can be performed on the actual article as a nondestructive test, they shall be tested on the article. If these tests are considered destructive in nature (such as burst disks), these tests shall be component tests of the same lot that will be used on flight articles. The lot sample shall be 10 percent of the lot but not less than 5 units, whichever is greater.

APPENDIX 4B4
BATTERY TEST REQUIREMENTS

Table 4B4-2
Silver Zinc Battery Qualification Test Matrix
(Page 1 of 2)

TEST	TEST REQUIREMENT	1	2	TEST GROUP
		3 *(a)*	**12** *(b)*	**QUANTITY**
Product Examination				
Inspection	4B1.2.1	X	X	
Weight	4B1.2.2	X	X	
Dimensions	4B1.2.3	X	X	
Identification	4B1.2.4	X	X	
X-Ray	4B4.1.2	X	X	
Battery and Cell Venting	4B4.1.3	X	X	
Safety Devices *(c)*	4B4.1.4	X	X	
Proof Pressure/Leak Test	4B4.1.5	X	X	
Electrolyte	4B4.1.6	X	X	
Electrical Tests				
Insulation Resistance	4B4.1.7	X	X	
Monitoring Devices	4B4.1.9	X	X	
Connector Pins Verification	4B4.1.10	X	X	
Heater Circuit Resistance	4B4.1.11	X	X	
Heater Circuit Operation	4B4.1.12	X	X	
Non-Operating Environment Tests				
Storage Temperature	4B1.3.1	X	X	
Transportation Shock/Bench Handling	4B1.3.3	X	X	
Transportation Vibration	4B1.3.4	X	X	
Fungus Resistance	4B1.3.5	X		
Salt Fog	4B1.3.6	X		
Fine Sand	4B1.3.7	X		
Activation	4B4.1.13	X	X	
Leakage Current	4B4.1.14	X		
No Load Voltage	4B4.1.15	X	X	
Qualification Load Test	4B4.1.17	X	X	
Reference Test				
Qualification Load Test *(d)*	4B4.1.16	X	X	

(a) Paragraph 4B4.1.1.4 Provides the additional testing units required for secondary silver zinc batteries.
(b) Test group 2 are cells only; also see paragraphs 4B4.1.1.3.
(c) If these tests can be performed on the actual article as a non-destructive test, they shall be tested on the article. If the tests are considered destructive in nature (such as burst disks), the article shall be from the lots that have successfully passed the lot acceptance test.
(d) This test is applicable to operating environment tests as described in paragraph 4B4.1.17. Actual load pulse (amperage and time) will be determined by manufacturer with Range Safety concurrence.

APPENDIX 4B4
BATTERY TEST REQUIREMENTS

Table 4B4-2
Silver Zinc Battery Qualification Test Matrix
(Page 2 of 2)

TEST	TEST REQUIREMENT	1 3 *(a)*	2 12 *(b)*	TEST GROUP QUANTITY
Operating Environment Tests				
Wet Stand Time	4B4.1.19	X	X	
Overcharge	4B4.1.18	X		
Humidity	4B1.4.1.2	X		
Acoustic	4B1.4.1.3	X	X	
Shock	4B1.4.1.4	X	X	
Acceleration	4B1.4.1.5	X	X	
Sinusoidal Vibration	4B1.4.1.6	X	X	
Random Vibration	4B1.4.1.1	X	X	
Thermal Cycling *(e)(f)*	4B1.4.1.7	X	X	
Temperature, Altitude, Humidity	4B4.1.20	X	X	
EMI/EMC	4B1.4.1.9	X		
Discharge Design Capacity	4B4.1.21	X	X	
Leak Test	4B4.1.5	X	X	
Inspection(Destructive Physical Analysis) *(g)*	4B4.1.22	X	X	
Destructive Test				
Explosive Atmosphere *(h)*	4B1.4.1.10	X		

(e) Temperature limits shall be 10°C above maximum flight predicted high temperature and 10°C below maximum flight predicted low temperature. The minimum temperature margin of -10°C can be reduced to -10°F provided that a temperature sensor is within the battery and measurement tolerance of the sensor and telemetry system are less than 1.0^{O}F.

(f) The number of thermal cycles shall be 8.

(g) To be performed after explosive atmosphere has been completed

(h) An electrical battery simulator/mockup can be use for this test.

APPENDIX 4B4
BATTERY TEST REQUIREMENTS

Table 4B4-3
Silver Zinc Battery Storage Life Verification Test Matrix

TEST	TEST REQUIREMENT	QUANTITY 2 CELLS/YEAR *(a)*
Product Examination		
Visual Inspection	4B1.2.1	100%
Weight	4B1.2.2	100%
Dimensions	4B1.2.3	100%
Identification	4B1.2.4	100%
X-Ray	4B4.1.2	100%
Battery and Cell Venting	4B4.1.3	100%
Proof Pressure/Leak Test	4B4.1.5	100%
Electrolyte	4B4.1.6	100%
Electrical Tests		
Insulation Resistance	4B4.1.7	100%
Activation	4B4.1.13	100%
Leakage Current	4B4.1.14	100%
No-Load Voltage	4B4.1.15	100%
Qualification Load Test *(b)*	4B4.1.17	100%
Operating Environment Tests		
Acoustic	4B1.4.1.3	100%
Shock	4B1.4.1.4	100%
Acceleration	4B1.4.1.5	100%
Random Vibration	4B1.4.1.2	100%
Thermal Cycling *(c)(d)*	4B1.4.1.7	100%
Temperature, Altitude, Humidity	4B4.1.20	100%
Discharge Design Capacity	4B4.1.21	100%
Leak Test	4B4.1.5	100%
Inspection(Destructive Physical Analysis)	4B4.1.22	100%

(a) Reference paragraph 4B4.1.1.2.
(b) This test is applicable to operating environment tests as described in paragraph 4B4.1.17. Actual load pulse (amperage and time) will be determined by manufacturer with Range Safety concurrence.
(c) Temperature limits shall be 10°C above maximum flight predicted high temperature and 10°C below maximum flight predicted low temperature. The minimum temperature margin of -10°C can be reduced to -10°F provided that the combined temperature sensor and telemetry system tolerances are less than 1.0°F.
(d) The number of thermal cycles shall be 8.

APPENDIX 4B4
BATTERY TEST REQUIREMENTS

4B4.1 Silver Zinc Batteries

4B4.1.1 Scope

4B4.1.1.1 Silver Zinc Battery Failure Analysis

If a failure occurs or there is evidence of an internal cell failure or other similar damage that affects the performance testing of the battery, perform a full teardown analysis of the battery and affected cell.

4B4.1.1.2 Silver Zinc Battery Initial Production Buy and Storage Verification

a. Purpose. To ensure that dry and wet stand times have not affected the performance of a specific battery

b. Conditions

1. Initial procurement of flight production batteries shall include 2 additional cells per year of the manufacturer stated capability.

2. These cells shall be of the same lot when they are procured and electrically conditioned the same way as the other batteries and/or cells.

c. Procedure. At the end of each year, test 2 cells in accordance with the Storage Life Verification Test Matrix.

4B4.1.1.3 Silver Zinc Battery Qualification

a. Purpose

1. To verify that the chemical process is as predicted, that there are no additional chemical formations, and that the cell structure has not changed except for specifically predicted changes such as, enlargement of cell cases due to electrolyte soakage and slight electrode plate dimension change.

2. To develop baseline data for future investigations of any failure during production. **NOTE:** These tests are required of all the cells and/or battery systems that do not have specific development data of the cell construction to be tested.

3. To verify integrity of the mechanical properties of the battery and cells.

b. Conditions

1. Two test groups are required for qualification. Test Groups consist of full production-type batteries. Test Group 2 is composed of individual cells from the same lot used to form the qualification batteries.

2. A minimum of 12 cells is required for qualification testing (Test Group 2). **NOTE:** The quantity may be modified depending on the cell design and the manufacturer capability to provide an internal investigation of the cells.

3. To verify integrity of the mechanical properties of the battery and cells.

c. Pass/Fail Criteria

1. The data shall show the chemical transformation that the cell processes through from the first activation through the qualification environments to the end of discharge.

2. The qualification test plan shall include the manufacturer expected results such as chemical formation, swelling of plates, and crystal salt growth for these tests.

3. The pass/fail criteria of **Silver Zinc Battery Discharge and Capacity** and **Silver Zinc Battery/ Cell Inspection (Destructive Physical Analysis)** shall also be met.

4B4.1.1.4 Qualification of Secondary Cycle Batteries

a. Purpose. To provide the additional steps and quantities of batteries that are required for qualification of secondary batteries.

b. Procedure.

1. Operational environmental testing shall be conducted for each of the electrical cycles for all qualification batteries and cells. The batteries to be tested shall be at the end of each charge retention life for each cycle, with the final operational testing being accomplished at the end of the total specified wet stand time.

2. Alternative testing can include the use of additional batteries for testing for each electrical cycle. For example, if the specified number of electrical cycles is 2, three qualification batteries would be tested in the primary mode as outlined in the **Silver Zinc Battery Qualification Test Matrix** and an additional 3 batteries would be electrically cycled through the primary mode and then exposed to **the Silver Zinc Battery Qualification Test Matrix** on the second electrical cycle. The second set of three batteries will be tested at the end of the total specified wet stand time.

c. Pass/Fail Criteria

1. The data shall show the chemical transformation that the cell processes through from the first

APPENDIX 4B4
BATTERY TEST REQUIREMENTS

activation through the qualification environments to the end of discharge.

2. The qualification test plan shall include the manufacturer expected results such as chemical formation, swelling of plates, and crystal salt growth for these tests.

3. The pass/fail criteria of Silver Zinc Battery Discharge and Capacity and Silver Zinc Battery/ Cell Inspection (Destructive Physical Analysis) shall also be met.

4B4.1.1.5 Verification Cell Acceptance Tests

a. Purpose. To verify that the flight battery cells were manufactured the same as the qualification battery cells and have not been exposed to environments exceeding the qualification parameters through cell testing

b. Conditions. 1 cell per flight battery , having the same lot date code shall be attached to the battery from manufacturing acceptance tests to just prior to installation of battery in launch vehicle.

c. Procedure

1. The cell shall be discharged at a moderate steady state rate to “end of voltage.”

2. The cell shall be cycled through the specified number of electrical cycles utilizing the same discharge rate as step 1.

c. Pass/Fail Criteria. The cell shall demonstrate the amp hour capacity consistent with the qualification data. **NOTE:** This may exceed the specified value or warranted value.

4B4.1.2 Silver Zinc Battery X-Ray

a. Purpose. To non-destructively inspect structural welds of battery and cells

b. Procedure. Perform X-Ray and inspection on all welds of the cell and battery in accordance with MIL-STD-453.

c. Pass/Fail Criteria. The X-ray evaluation shall be in accordance with the accept/reject criteria that is established by the battery specification

4B4.1.3 Silver Zinc Battery and Cell Venting

a. Purpose. To verify cracking and reset pressure

b. Condition. Prior to using pressure relief devices incorporated into the battery and cell for qualification and acceptance testing, pressure relief devices shall be tested individually.

c. Procedure. Test the battery container vent pressure relief device in accordance with the manufacturer accepted test procedure.

d. Pass/Fail Criteria. The pressure relief device shall meet component specifications.

4B4.1.4 Silver Zinc Battery Safety Devices

a. Purpose. To demonstrate that safety devices are within design tolerance

b. Procedure

1. Lot acceptance test 100 percent of the safety devices that can be tested nondestructively.

2. Test a 10 percent lot sampling of each safety device such as burst discs, fuses, and diodes that acceptance testing would be considered destructive.

c. Pass/Fail Criteria. Safety devices shall meet design criteria.

4B4.1.5 Silver Zinc Battery Proof Pressure and Leak

a. Purpose. To verify that pressurized cells and batteries can withstand a proof pressure of 1.5 times the worst case operating pressure

b. Condition. The battery and/or cell shall be at room temperature.

c. Procedure

1. Pressurize the battery/cell with dry nitrogen or other appropriate gas to 1.5 times the component specified maximum operating pressure.

2. Monitor the pressure with a gauge or pressure transducer for a 1 h period at room temperature.

d. Pass/Fail Criteria.

1. The pressure drop shall not decay in 1 h after the pressure source has been removed.

2. There shall be no deformation of the battery or cell case or associated fitting, including electrical connectors and pressure port.

4B4.1.6 Silver Zinc Battery Electrolyte

a. Purpose. To verify electrolyte is within specifications to ensure consistent battery performance

b. Procedure. Test the chemical composition of the battery activation electrolyte stock solution in accordance with the supplier approved test procedure.

c. Pass/Fail Criteria. Electrolyte shall meet chemical purity defined in specification.

APPENDIX 4B4
BATTERY TEST REQUIREMENTS

4B4.1.7 Silver Zinc Battery Insulation Resistance

a. Purpose. To measure the resistance offered by the insulating material to an impressed direct voltage that could produce a leakage current. **NOTE:** This measurement should not be considered the equivalent of dielectric withstanding voltage tests.

b. Conditions

1. The insulation resistance test shall be performed prior to activation of the battery.

2. A second insulation resistance test shall be performed after activation of the battery.

c. Procedure. Measure the insulation resistance between the following mutually insulated components:

1. All battery connector pins and end of wire harness that would attach to cell terminals (pin-to-pin) at a potential of 500 ± 25 VDC.

2. Each connector pin and battery case (pin-to-case) at a potential of 500 ± 25 VDC.

d. Pass/Fail Criteria. The insulation resistance shall be 2 megohms or greater.

4B4.1.8 Intentionally Left Blank

4B4.1.9 Silver Zinc Battery Monitoring Devices

a. Purpose. To verify operation of temperature, voltage, and current monitoring devices prior to installation and after full battery assembly

b. Condition. The monitoring device test shall be performed at the piece part level and after the device has been installed.

c. Procedure. Test the measurement ranges of voltage, temperature, and current monitoring devices.

d. Pass/Fail Criteria. The voltage, temperature, and current monitoring devices shall be within the maximum and minimum range of the manufacturer specifications.

4B4.1.10 Silver Zinc Battery Connector Pins Verification

a. Purpose. To verify wires and associated connector pins are connected per the specification and drawing

b. Condition. Connector pin assignment shall be verified after installing the wiring but prior to activating the cell.

c. Procedure. Perform a continuity and isolation check to verify the proper pin assignments of all electrical connectors and pins. **NOTE:** Recommended isolation is 2 megohms and recommended continuity measurement is less than 0.05 ohms.

4B4.1.11 Silver Zinc Battery Heater Circuit Resistance

a. Purpose. To verify that thermistors used in heater circuits have not been damaged during installation

b. Procedure. Measure the heater circuit resistance, after installation in the battery case.

c. Pass/Fail Criteria. The heater circuit resistance shall meet the requirements of the applicable specification.

4B4.1.12 Silver Zinc Battery Heater Circuit Operations

a. Purpose. To verify complete heater circuit response at the proper external temperature

b. Procedure. Test the heater circuit operation at the low and high settings.

c. Pass/Fail Criteria. Heater circuit operation shall meet the requirements of the applicable specification.

4B4.1.13 Silver Zinc Battery/Cell Activation

a. Purpose. Activate batteries and cells.

b. Procedure. The activation shall be per manufacturer’s procedure.

c. Pass/Fail Criteria. Deviations to the activation procedure will result in rejection of the battery or cell.

4B4.1.14 Silver Zinc Battery Leakage Current

a. Purpose. To verify no current leakage path due to spilled or leaked electrolyte

b. Conditions

1. This shall be performed after the no load and acceptance load test.

2. Voltage measurements shall be made using a digital voltmeter with a 100 kilohm resistor across the input.

c. Procedure. Perform voltage measurements from each connector pin (or cell terminal) to case for all connectors.

d. Pass/Fail Criteria. There shall be no voltages

APPENDIX 4B4
BATTERY TEST REQUIREMENTS

greater that 0.0 millivolts.

4B4.1.15 Silver Zinc Battery No Load Voltage

a. Conditions

1. Open circuit voltage shall be verified without any load applied, immediately after activation and 48 h after soak.

2. Open circuit voltage measurements shall be made with a high impedance digital voltmeter having a current of 1.0 mA or less.

b. Procedure. Measure the open circuit voltage of the battery and each individual cell.

c. Pass/Fail Criteria. The open circuit voltage of the battery and individual cells shall meet the requirements of the applicable specification.

4B4.1.16 Silver Zinc Battery Acceptance Load

a. Conditions

1. The load shall be applied immediately after no load voltage measurements.

2. There shall not be a "no-load" interruption between application of loads.

b. Procedure

1. Subject the battery to a constant current load (equal to the load that is required when the RSS is on "internal") for 1 min.

2. Subject the battery to a pulse load that is equal to the maximum load that is required to support the RSS, (commonly the issuance of a DESTRUCT command) for 10 sec.

c. Pass/Fail Criteria. At no time shall the battery voltage fall below the minimum qualified voltage of the receiver and other RSS electrical components.

4B4.1.17 Silver Zinc Battery Qualification Load

a. Purpose. To ensure a qualification load application during actual environmental stresses do not reduce the battery voltage below the qualified voltage of the electronic components.

b. Conditions

1. The test equipment shall be set up to measure the resulting battery and/or cell characteristics. **NOTE:** The resolution of these measurements shall be 0.01 volts, 0.001 amps, and 0.0001 sec.

2. The battery and/or cell characteristics shall be graphed according to the following criteria:

(a) Y axis = voltage

(b) X axis = time

(c) A clearly marked horizontal line on the X axis shall show the minimum acceptable voltage.

(d) When and what magnitude loads are applied or removed shall be clearly indicated.

3. There shall not be a no-load interruption between the application of loads.

c. Procedures

1. Apply a steady state load to the battery for the duration of the test and include all loads the battery will be required to sustain during flight with the exception of the actual commanding of ARM and DESTRUCT.

2. Apply a current pulse after the steady state load test. The current pulse shall be based on two times the pulse width or 100 msec, whichever is greater, and two times the required pulse amperage that is used in the system for sending ARM and DESTRUCT commands and firing the initiator.

3. Thermal Cycling. During the first, middle, and last cycles of the thermal cycling test, perform the steady state load test and the current pulse test at the high and low temperature extremes soak time.

4. Temperature, Altitude, and Humidity. During the all three cycles of the temperature, altitude, and humidity operating environment test, perform the steady state load and the current pulse test at the high and low temperature extremes soak times.

5. Random Vibration. Perform the steady state and the current pulse test during each axis of random vibration.

6. Shock.

(a) Perform the steady state test during each shock test.

(b) Perform the steady state test for a minimum of 180 sec and the current pulse test after each axis shock.

d. Pass/Fail Criteria. The battery voltage shall not fall below the minimum qualified voltage of the electronic components.

4B4.1.18 Silver Zinc Battery/Cell Overcharge

a. Purpose. To demonstrate the capability of the battery and test cells to accept on overcharge condition.

APPENDIX 4B4
BATTERY TEST REQUIREMENTS

b. Procedure. Apply an overcharge to the battery or cell using a nominal charging rate up to the specified limit.

c. Pass/Fail Criteria. The battery (or cell) shall pass all qualification tests after the overcharge has been applied.

4B4.1.19 Silver Zinc Battery Wet Stand Time

a. Purpose. To verify the battery performance is not degraded after a 60 day wet stand time.

b. Conditions. The battery shall be stored in the same manner that actual flight batteries will be handled. Storage conditions shall take into account battery laboratory and launch vehicle stand environments.

c. Procedure

1. Activate the battery and let it stand for 60 days or whatever time the manufacturer's specified wet stand allows, whichever is greater, prior to operating environment tests.

2. Perform OCV tests on a periodic basis to document self-discharge characteristics.

3. Perform a load test after the initial OCV measurement to verify the chemical state of the battery.

d. Pass/Fail Criteria. Successfully complete operational testing and capacity requirement after a 60 day or the manufacturer's wet stand time.

4B4.1.20 Silver Zinc Battery Temperature, Altitude, and Humidity

NOTE 1: If this test is performed in its entirety, the Humidity Test and 3 cycles of the Thermal Cycling Test required in the Qualification Text Matrix will not have to be performed. **NOTE 2:** Refer to testing appendix for the required temperature margin.

a. Purpose

1. To ensure proper battery voltage regulation and mechanical stability of the battery and cells during varying temperatures, humidities, and altitude.

2. To ensure that the generation of gas does not force electrolyte from cells.

b. Procedure

1. High Temperature Step

(a) Place the battery in a test chamber that is maintained at sea level pressure with the temperature maintained at the maximum expected temperature plus 10^o, and with the relative humidity maintained at 95 percent.

(b) Maintain these conditions for 4 h.

2. Low Temperature Step

(a) Reduce the temperature to the minimum expected temperature minus 10^o with no humidity control.

(b) When the temperature of the battery has stabilized, perform a qualification load test.

3. Altitude Step

(a) In a period of 5 to 10 min, reduce the chamber pressure to 0.0001 Torr or less with no temperature or humidity control.

(b) When the chamber pressure reaches 0.0001 Torr, perform another qualification load test.

4. High Temperature Step 2

(a) Return the chamber to standard atmospheric conditions and the battery to the maximum expected temperature plus 10^o.

(b) When the chamber and battery stabilize, perform another qualification load test.

5. 0^oF Step

(a) Maintain the chamber pressure at standard atmospheric conditions and reduce the chamber temperature to 0^oF.

(b) If temperature is maintained with heaters, the following steps shall be performed at 0^oF:

(1) Cycle the battery heaters through a heater cycle for minimum battery and temperature stabilization.

(2) Disconnect the heater power.

(3) After the battery has cooled down to the temperature that the heater would just turn on (thermostat setting), repeat the qualification load test.

6. Standard Atmospheric Condition Step

(a) When the temperature of the chamber has stabilized, bring the battery to standard atmospheric conditions (temperature and humidity).

(b) Perform another qualification load test.

7. Repeat the temperature, altitude, and humidity test described in steps *1* through *6* for two additional cycles for a total of three cycles.

4B4.1.21 Silver Zinc Battery Discharge and Capacity

APPENDIX 4B4
BATTERY TEST REQUIREMENTS

a. Purpose

1. To verify sufficient battery capacity is equal to or greater than 150 percent of the mission time for which Range Safety has flight safety responsibility or 30-min hang-fire hold time plus mission time. The mission time includes the minus count time starting when the FTS has switched to the final internal power configuration (battery) through normal flight, with two ARM and DESTRUCT commands at the end of the time period. **NOTE:** The 30-min, hang-fire hold time applies only to vehicles using solid propellants and vehicles using solid propellant ignition systems.

2. To verify battery capacity is equal to or greater than the manufacturer warranted capacity.

b. Conditions

1. The capacity evaluation shall be performed after all operational environment tests.

2. The capacity evaluation shall be performed at room temperature.

c. Procedure

1. Discharge each battery.

2. Use a C/2 discharge rate to the cutoff voltage. **NOTE:** This cutoff depends on the lowest specified voltage of the electronic components or the manufacturer cutoff voltage, whichever is greater. For example, receivers are tested to a minimum of 24 VDC.

3. Monitor the battery and/or cell voltage and current.

4. Graph the results on a voltage versus time plot in accordance with the following criteria:

(a) Y axis = voltage

(b) X axis = time

(c) A clearly marked horizontal line on the X axis shall show the minimum acceptable voltage.

(d) When and what magnitude loads are applied or removed shall be clearly indicated.

d. Pass/Fail Criteria. At a minimum, the capacity demonstrated during this test and the amp-hour drawn during the operational environmental tests shall be the manufacturer warranted rating and be equal to, or greater than, 150 percent of the capacity that is required for actual use.

4B4.1.22 Silver Zinc Battery/Cell Inspection (Destructive Physical Analyses)

a. Purpose. To verify the proper chemical state and the actual physical construction of the cell

APPENDIX 4B4
BATTERY TEST REQUIREMENTS

b. Conditions

1. Inspection shall be performed after completion of all environmental tests.

2. All cells shall be used for internal investigation.

3. The battery shall be disassembled and its cells removed for physical inspection.

c. Procedure

1. Record the open circuit voltage (OCV) of each cell in both Test Groups.

2. Internally inspect all battery wiring and cell interconnects and potting/shimming materials.

3. Discharge the batteries and individual cells at a C/2 rate to the manufacturer cutoff voltage.

4. Disassemble the batteries to gain access to all cells. The cell disassembly procedure shall be coordinated with Range Safety.

5. Leak check each cell.

6. Upon completion of discharge for capacity, all cells shall be discharged and subject to tear down and inspection.

7. Destructive physical analysis shall be performed on six cells minimum (one from each corner and two from the middle of each battery). At a minimum, the inspection shall include the following visual examinations with photography, when possible and observations recorded.

Plate Tabs - connection integrity
Plates - plate color, plate shape (size)
Separator - condition, silver migration, oxalate crystals.

d. Pass/Fail Criteria

1. The capacity shall met the requirements of the **Silver Zinc Battery Discharge and Capacity** section of this Appendix.

2. The inspection shall verify the chemical state of the battery and the physical construction of the battery and cells.

3. A component that exhibits any sign that an internal part is stressed beyond its design is considered a failure of the component under test even if the component passes the final functional test.

APPENDIX 4B5
MISCELLANEOUS COMPONENT TEST REQUIREMENTS

Table 4B5-1
Miscellaneous Component Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Product Examination		
Visual	4B1.2.1	100%
Weight	4B1.2.2	100%
Dimension	4B1.2.3	100%
Identification	4B1.2.4	100%
Functional Test *(a)*		
TBD		100%
Reference Functional Test *(b)*		
TBD		100%
Operating Environment Tests		
Acoustic	4B1.4.2.2	100%
Acceleration	4B1.4.2.3	100%
Thermal Cycling *(c)*	4B1.4.2.4	100%
Thermal Vacuum *(d)*	4B1.4.2.5	100%
Random Vibration	4B1.4.2.1	100%
Burn-In	4B1.4.2.6	100%
Leakage *(e)*	4B1.2.7	100%

(a) These tests shall be performed prior to and after each environmental test.
(b) This test shall be performed during the operating environment tests.
(c) The full functional tests shall be performed at high voltage input on the 1 and 7 cycles, low voltage input on the 2 and 8 cycles, and reference functional tests for the remaining cycles at nominal voltage input.
(d) The full functional test shall be performed during the high and low temperature soak period.
(e) This test shall be performed after the last operating environment test.

APPENDIX 4B5
MISCELLANEOUS COMPONENT TEST REQUIREMENTS

Table 4B5-2
Miscellaneous Component Qualification Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		1	1	1
Acceptance	ACCEPTANCE TEST MATRIX	X	X	X
Functional Test *(a)*				
TBD	TBD	X	X	X
Reference Functional Test				
TBD *(b)*	TBD	X	X	X
TBD *(c)*	TBD	X	X	X
Non-Operating Environment Tests				
Storage Temperature	4B1.3.1	X	X	X
Transport Shock/Bench Hand-	4B1.3.3	X	X	X
ling	4B1.3.4	X	X	X
Transportation Vibration	4B1.3.5	X		
Fungus Resistance	4B1.3.6		X	
Salt Fog	4B1.3.7			X
Fine Sand				
Operating Environment Tests				
Sinusoidal Vibration	4B1.4.1.1	X	X	X
Acoustic	4B1.4.1.3	X	X	X
Shock	4B1.4.1.4	X	X	X
Acceleration	4B1.4.1.5	X	X	X
Humidity	4B1.4.1.6			X
Thermal Cycling *(d)*	4B1.4.1.7	X	X	X
Thermal Vacuum *(e)*	4B1.4.1.8	X	X	X
Random Vibration	4B1.4.1.2	X	X	X
EMI/EMC	4B1.4.1.9		X	X
Explosive Atmosphere	4B1.4.1.10	X		
Leakage *(f)*	4B1.2.7	X	X	X
Disassembly	4B1.4.1.11	X	X	X

(a) This test shall be performed after all non-operating environment tests have been completed. This test shall also be performed after all operating environment tests have been completed.
(b) These tests shall be performed prior to and after each environmental test.
(c) This test shall be performed during the operating environment tests.
(d) The full functional tests shall be performed at high voltage input on the 1 and 23 cycles, nominal voltage on the 12 and 13 cycles, low voltage input on the 2 and 24 cycles, and reference functional tests for the remaining cycles at nominal voltage input.
(e) TBD tests shall be performed during the high and low temperature soak periods.
(f) This test shall be performed after the last non-operating and the last operating environment tests.

APPENDIX 4B6
S&A AND EED TEST REQUIREMENTS

Table 4B6-1
S&A Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Product Examination		
Visual	4B1.2.1	100%
Weight	4B1.2.2	100%
Dimension	4B1.2.3	100%
Identification	4B1.2.4	100%
Functional Test *(a)*		
Full Bench Test	4B6.1	100%
Reference Functional Test *(b)*		
Limited Bench Test	4B6.2	100%
Operating Environment Tests		
Thermal Cycling *(c)(d)*	4B1.4.2.4	100%
Random Vibration *(e)*	4B1.4.2.1	100%
X-Ray	4B1.2.5	100%
N-Ray	4B1.2.6	100%
Leakage *(f)*	4B1.2.7	100%

(a) These tests shall be performed prior to and after all environmental tests.
(b) This test shall be performed prior to the random vibration test.
(c) Bridgewire resistance shall measured at high and low temperature on the first, middle, and last cycles.
(d) The number of thermal cycles shall be 8 with dwell time of 1 h at each temperature extreme (-24^{0}C to +61^{0}C) or the MPE, whichever is more severe.
(e) During random vibration testing, the S&A ARM/SAFE telemetry circuits and firing line circuits shall be continuously monitored for status and chatter respectively
(f) This test shall be performed after the last operating environment test.

APPENDIX 4B6
S&A AND EED TEST REQUIREMENTS

Table 4B6-2
S&A Qualification Test Matrix
(Page 1 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED			
		1	1	6	3
Acceptance	ACCEPTANCE TEST MATRIX	X	X	X	
Functional Test *(a)*					
Full Bench Test	4B6.1	X		X	
Reference Functional Test *(b)*					
Limited Bench Test	4B6.2	X		X	
Non-Operating Environment Tests					
Storage Temperature	4B1.3.1	X		X	
Transport Shock/Bench Handling	4B1.3.3	X		X	
Transportation Vibration	4B1.3.4	X		X	
Fungus Resistance	4B1.3.5	X			
Salt Fog	4B1.3.6	X			
Fine Sand	4B1.3.7	X			
Operating Environment Tests					
Stall, 5 min	4B6.4.1	X		X	
Sinusoidal Vibration *(c)*	4B1.4.1.1	X		X	
Shock *(c)*	4B1.4.1.4	X		X	
Acceleration *(c)*	4B1.4.1.5	X		X	
Humidity	4B1.4.1.6	X		X	
Thermal Cycling *(d)(e)*	4B1.4.1.7	X		X	
Random Vibration *(c)*	4B1.4.1.2	X		X	
Explosive Atmosphere	4B1.4.1.10	X			
Leakage *(f)*	4B1.2.7	X		X	
Disassembly	4B1.4.1.11			2	
Firing Test at Operating Current *(g)*					
At High Temperature *(h)*	4B6.7			2	
At Low Temperature *(i)*	4B6.7			2	

(a) These tests shall be performed after all non-operating environment tests have been completed and after all operating environment tests have been completed.
(b) These tests shall be performed after each environmental test (operating and non-operating) excluding leakage, explosive atmosphere, and disassembly.
(c) During these tests, the S&A ARM/SAFE telemetry circuits and firing line circuits shall be continuously monitored for status and chatter respectively.
(d) Bridgewire resistance shall be measured at high and low temperature on the first, middle, and last cycles.
(e) The number of thermal cycles shall be 24 with dwell time of 2 h at each temperature extreme (-54☜C to +71☜C) or the MPE, whichever is more severe.
(f) This test shall be performed after the last non-operating and the last operating environment test.
(g) In the event that operating current cannot be predicted, the test current shall be 2 times the Bruceton All-Fire Current.
(h) Fire at designed high temperature or +71^{o}C whichever is higher.
(i) Fire at designed low temperature or -54^{o}C whichever is lower.

APPENDIX 4B6
S&A AND EED TEST REQUIREMENTS

Table 4B6-2
S&A Qualification Test Matrix
(Page 2 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED			
		1	1	6	3
Safety Test					
Cycle Life *(j)*	4B6.3	X			
Stall, 60 min *(j)*	4B6.4.2	X			
6-ft Drop Test *(k)*	4B6.5.1		X		
20-ft Drop Test *(j)*	4B6.5.2	X			
Visual Inspection *(l)*	- - -	X			
Barrier Test *(m)*	4B6.6				X

(j) The S&A exposed to these tests shall not be fired.
(k) The limited bench test shall be performed after this test. Also, the S&A shall be fired at ambient temperature after the limited bench test.
(l) The S&A shall be inspected for hazardous conditions prior to disposal.
(m) Test units that duplicate all dimensions shall be used, including gaps between explosive components, free volume, and diaphragm thickness (if used) of the operational S&A. The explosive transfer assemblies that are normally mated to the S&A in flight shall be used.

APPENDIX 4B6
S&A AND EED TEST REQUIREMENTS

Table 4B6-3
EED Lot Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Non-Destructive Tests		
Visual Inspection	4B1.2.1	100%
Dimension	4B1.2.3	100%
Leakage	4B1.2.7	100%
Static Discharge	4B6.8	100%
Pull Test *(a)*	4B1.3.8	100%
Bridgewire Resistance	4B6.9	100%
Insulation Resistance	4B6.10	100%
X-Ray	4B1.2.5	100%
N-Ray	4B1.2.6	100%
Destructive Tests		
Shock *(b)*	4B1.4.1.4	Lot Sample *(c)*
Thermal Cycling *(b)(d)*	4B1.4.1.7	Lot Sample
High Temp Storage *(e)*	4B6.18	Lot Sample
Random Vibration *(b)*	4B1.4.1.2	Lot Sample
X-Ray	4B1.2.5	Lot Sample
N-Ray	4B1.2.6	Lot Sample
Bridgewire Resistance	4B6.9	Lot Sample
Insulation Resistance	4B6.10	Lot Sample
Leakage	4B1.2.7	Lot Sample
No Fire Verification	4B6.11	Lot Sample
Firing Tests		
Ambient Temperature		
All-Fire Current *(f)*	4B6.16	1/6 Lot Sample
Operating Current *(g)*	4B6.16	1/6 Lot Sample
High Temperature *(h)*		
All-Fire Current *(f)*	4B6.16	1/6 Lot Sample
Operating Current *(g)*	4B6.16	1/6 Lot Sample
Low Temperature *(i)*		
All-Fire Current *(f)*	4B6.16	1/6 Lot Sample
Operating Current *(g)*	4B6.16	1/6 Lot Sample

(a) This test may be performed as in manufacture process.
(b) Environmental tests shall be performed at qualification levels.
(c) Lot sample is 10 percent of lot but not less than 30 units.
(d) The number of thermal cycles shall be 24 with dwell time of 2 h at each temperature extreme.
(e) This test is optional. If performed, the lot has initial service life of 3 yr.
(f) All-Fire current is specified All-Fire current vs Bruceton All-Fire current.
(g) In the event that operating current cannot be predicted, the test current shall be 2 times the Bruceton All-Fire Current.
(h) Fire at designed high temperature or +71^{o}C whichever is higher.
(i) Fire at designed low temperature or -54^{o}C whichever is lower.

APPENDIX 4B6
S&A AND EED TEST REQUIREMENTS

Table 4B6-4
EED Qualification Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED									
		120 *(a)*	230 *(b)*	45	45	5	5 *(c)*	6	5	5	105
Acceptance (Non-Destructive Test)	ACCEPTANCE TEST MATRIX	X	X	X	X	X	X	X	X	X	X
RF Impedance	4B6.12		10								
RF Sensitivity	4B6.13		X*(d)*								
RF Dudding	4B6.14	X									
No Fire Bruceton	4B6.15			X							
All-Fire Bruceton	4B6.15				X						
High Temp. Exposure	4B1.3.2					X					
Shock	4B1.4.1.4									X	X
Thermal Cycling *(e)*	4B1.4.1.7								X	X	X
High Temp. Storage *(f)*	4B6.18										30
Random Vibration	4B1.4.1.2										X
Drop Test (6 Foot)	4B1.3.9									X	X
Drop Test (40 Foot)	4B1.3.10						X				
Bridgewire Res.	4B6.9								X	X	X
Insulation Res.	4B6.10								X	X	X
Leakage	4B1.2.7								X	X	X
X-Ray	4B1.2.5								X	X	X
N-Ray	4B1.2.6								X	X	X
No Fire Verification	4B6.11							X	X	X	X
Firing Tests:											
Ambient Temperature											
All-Fire Current *(g)*	4B6.16							X	X	X	
Ambient Temp.											
All-Fire Current *(g)*	4B6.16										15
Oper. Current *(h)*	4B6.16										15
22 Amps Current	4B6.16										5
High Temp. *(i)*											
All-Fire Current *(g)*	4B6.16										15
Oper. Current *(h)*	4B6.16										15
22 Amps Current	4B6.16										5
Low Temp. *(j)*											
All-Fire Current *(g)*	4B6.16										15
Oper. Current *(h)*	4B6.16										15
22 Amps Current	4B6.16										5

(a) These tests are not required if the EEDs will not be exposed to RF levels greater than the RF no-fire level, as determined by the RF sensitivity testing. The maximum RF exposure level is that maximum level determined by a worst case electromagnetic hazard analysis approved by Range Safety.
(b) Number indicated is for single Bridgewire. For dual Bridgewire, increase number to 370.
(c) This test is not required if EED contained inside the S&A body.
(d) Underlining indicates units are considered destroyed.
(e) The number of thermal cycles shall be 24 with dwell time of 2 h at each temperature level.
(f) This test is optional. If performed, the lot has initial service life of three years.
(g) All-Fire current is specified All-Fire current vs Bruceton All-Fire current.
(h) In the event that operating current cannot be predicted, the test current shall be 2 times Bruceton All-Fire Current.
(i) Fire at designed high temperature or +71 degrees C whichever is higher.
(j) Fire at designed low temperature or -54 degrees C whichever is lower.

APPENDIX 4B6
S&A AND EED TEST REQUIREMENTS

Table 4B6-5
EED Age Surveillance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED	
		5 *(a)*	10 *(b)*
Non-Destructive Tests			
Visual Inspection	4B1.2.1	X	X
Dimension	4B1.2.3	X	X
Bridgewire Resistance	4B6.9	X	X
Leakage	4B1.2.7	X	X
Static Discharge	4B6.8	X	X
Bridgewire Resistance	4B6.9	X	X
Insulation Resistance	4B6.10	X	X
X-Ray	4B1.2.5	X	X
N-Ray	4B1.2.6	X	X
Destructive Tests			
Shock *(c)*	4B1.4.1.4	X	X
Thermal Cycling *(c) (d)*	4B1.4.1.7	X	X
High Temperature Storage	4B6.18		X
Random Vibration *(c)*	4B1.4.1.2	X	X
X-Ray	4B1.2.5	X	X
N-Ray	4B1.2.6	X	X
Bridgewire Resistance	4B6.9	X	X
Insulation Resistance	4B6.10	X	X
Leakage	4B1.2.7	X	X
No Fire Verification	4B6.11	X	X
Firing Tests			
Ambient Temperature All-Fire Current *(e)*	4B6.16	1	4
High Temperature All-Fire Current (e)(f)	4B6.16	2	3
Low Temperature All-Fire Current (e)(g)	4B6.16	2	3

(a) Testing can be conducted to extend service life for one year
(b) Testing that can be conducted to extend service life for three years.
(c) Environmental tests shall be performed at qualification levels.
(d) The number of thermal cycles shall be 24 with dwell time of 2 h at each temperature cycle.
(e) All-Fire current is specified All-Fire current vs. Bruceton All-Fire current.
(f) Fire at design high temperature or +71^{o}C whichever is higher.
(g) Fire at design low temperature or -54^{o}C whichever is lower.

APPENDIX 4B6
S&A AND EED TEST REQUIREMENTS

Table 4B6-6
S&A Rotor Lead/Booster Charge Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Non-Destructive Tests		
Visual Inspection	4B1.2.1	100%
Dimension	4B1.2.3	100%
Leakage	4B1.2.7	100%
X-Ray	4B1.2.5	100%
N-Ray	4B1.2.6	100%
Destructive Tests		
Thermal Cycling *(a) (b)*	4B1.4.1.7	Lot Sample *(c)*
High Temp Storage *(d)*	4B6.18	Lot Sample
Random Vibration *(a)*	4B1.4.1.2	Lot Sample
Leakage	4B1.2.7	Lot Sample
X-Ray	4B1.2.5	Lot Sample
N-Ray	4B1.2.6	Lot Sample
Firing Tests		
High Temperature *(e)*	4B6.17	1/2 Lot Sample
Low Temperature *(f)*	4B6.17	1/2 Lot Sample

(a) Environmental tests shall be performed at qualification levels.
(b) Number of thermal cycles shall be 24 with dwell time of 2 h at each temperature cycle.
(c) The sample size is 10 percent of the lot, but not less than 10 units.
(d) This test is optional. If performed, the lot has initial service life of 3 yr.
(e) Fire at designed high temperature or +71^{o}C whichever is higher.
(f) Fire at designed low temperature or -54^{o}C whichever is lower

APPENDIX 4B6
S&A AND EED TEST REQUIREMENTS

Table 4B6-7
S&A Rotor Lead/Booster Charge Qualification Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED	
		6	21
Acceptance (Non-Dest. Test)	ACCEPTANCE TEST MATRIX	X	X
Destructive Tests			
Shock	4B1.4.1.4		X
Thermal Cycling *(a)*	4B1.4.1.7	X	X
High Temp Storage *(b)*	4B6.18		10
Random Vibration	4B1.4.1.2		X
X-Ray	4B1.2.5	X	X
N-Ray	4B1.2.6	X	X
Leakage	4B1.2.7	X	X
Firing Tests			
Ambient Temperature	4B6.17	2	7
High Temperature *(c)*	4B6.17	2	7
Low Temperature *(d)*	4B6.17	2	7

(a) Number of thermal cycles shall be 24 with dwell time of 2 h at each temperature cycle.
(b) This test is optional. If performed, the lot has initial service life of 3 yr.
(c) Fire at designed high temperature or +71^{o}C whichever is higher.
(d) Fire at designed low temperature or -54^{o}C whichever is lower.

APPENDIX 4B6
S&A AND EED TEST REQUIREMENTS

Table 4B6-8
S&A Rotor Lead/Booster Charge Age Surveillance Test Matrix

TEST	**TEST REQUIREMENT**	**QUANTITY TESTED**	
		5 *(a)*	10 *(b)*
Non-Destructive Tests			
Visual Inspection	4B1.2.1	X	X
Dimension	4B1.2.3	X	X
Leak	4B1.2.7	X	X
X-Ray	4B1.2.5	X	X
N-Ray	4B1.2.6	X	X
Destructive Tests			
Thermal Cycling *(c) (d)*	4B1.4.1.7	X	X
High Temperature Storage	4B6.18		X
Random Vibration *(c)*	4B1.4.1.2	X	X
Leakage	4B1.2.7	X	X
X-Ray	4B1.2.5	X	X
N-Ray	4B1.2.6	X	X
Firing Tests			
High Temperature *(e)*	4B6.17	2	5
Low Temperature *(f)*	4B6.17	3	5

(a) Testing that can be conducted to extend service life for one year.
(b) Testing that can be conducted to extend service life for three years.
(c) Environmental tests shall be performed at qualification level.
(d) Number of thermal cycles shall be 24 with dwell time of 2 h at each temperature cycle.
(e) Fire at designed high temperature or +71^{o}C whichever is higher.
(f) Fire at designed low temperature or -54^{o}C whichever is lower.

APPENDIX 4B6
S&A AND EED TEST REQUIREMENTS

4B6.1 Full Bench Test

a. Purpose

1. To verify that the component is capable of cycling within its specified operating time

2. To verify the insulation resistances and firing circuit resistances in each operating mode

3. To verify the capability to manually safe the component

4. To confirm the effort that is needed to remove the safing pin and to determine the safing pin retention capability

b. Procedure

1. Remove the safing pin and measure the force/torque that is required to remove the pin.

2. Remotely arm the component and measure the cycle time.

3. Using the **Bridgewire Resistance** and **Insul-ation Resistance** tests, measure the component bridgewire resistance and insulation resistance.

4. Remotely safe the component.

5. Using the **Bridgewire Resistance** and **Insul-ation Resistance** tests, measure the component bridgewire resistance and insulation resistance.

6. Cycle the component (SAFE to ARM and ARM to SAFE) 25 more times and measure each cycle time.

7. Remotely return the component to its safe configuration.

8. Using the **Bridgewire Resistance** and **Insul-ation Resistance** tests, measure the component bridgewire resistance and insulation resistance.

9. Remotely arm the component and measure the cycle time.

10. Using the **Bridgewire Resistance** and **Insulation Resistance** tests, measure the component bridgewire resistance and insulation resistance.

11. Manually safe the component and measure the angular or the sliding displacement of safe rotation/travel if possible.

12. Verify that the S&A safing pin can be inserted and removed without binding.

13. Install the safing pin.

14. With the component in the SAFE position and the arming current applied, measure the retention capability of the safing pin.

c. Pass/Fail Criteria.

1. The component shall be capable of operating within the requirements of the component specification.

2. The resistances shall be within the component specification.

4B6.2 Limited Bench Test

a. Purpose

1. To verify that the device is capable of cycling within its specified operating time

2. To verify insulation resistances and firing circuit resistance in each operating mode

3. To verify the capability to manually safe the component

b. Procedure

1. Remotely arm the component and measure the cycle time.

2. Using the **Bridgewire Resistance** and **Insul-ation Resistance** tests, measure the component bridgewire resistance and insulation resistance.

3. Remotely safe the component.

4. Using the **Bridgewire Resistance** and **Insul-ation Resistance** tests, measure the component bridgewire resistance and insulation resistance.

5. Cycle the component (SAFE to ARM and ARM to SAFE) 5 more times and measure each cycle time.

6. Install the safing pin.

c. Pass/Fail Criteria

1. The component shall be capable of operating within the requirements of the component specifications.

2. The resistances shall be within the component specification.

4B6.3 Cycle Life

a. Purpose. To verify that the unit can withstand repeated cycling from the armed to the disarmed position for at least 1000 cycles without any malfunction, failure, or deterioration in electromechanical performance.

b. Procedure

1. Cycle the component 1000 times using nominal operational arming voltage.

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S&A AND EED TEST REQUIREMENTS

2. Perform a limited bench test in accordance with the **Limited Bench Test** section of this Appendix at every 1/3 interval of cycle life.

c. Pass/Fail Criteria. The component shall be capable of operating within the requirements of the component specifications.

4B6.4 Stall Test

4B6.4.1 5-Min Stall

a. Purpose. To verify that electrically actuated S&As will meet the specified electromechanical performance requirements after the application of maximum operational arming voltages continuously for up to 5 min with the safing pin installed.

b. Procedure

1. With the safing pin installed, apply a maximum value arming voltage for 5 min.

2. Verify the performance by performing a limited bench test in accordance with the **Limited Bench Test** section of this Appendix.

c. Pass/Fail Criteria. The component shall be capable of operating within the requirements of the component specification.

4B6.4.2 60-Min Stall

a. Purpose. To verify that the explosive that is in the S&A will not detonate after the application of maximum operational arming voltages continuously for up to 60 min with the safing pin installed

b. Procedure. With the safing pin installed, apply a maximum value arming voltage for 60 min.

c. Pass/Fail Criteria. The detonator/explosive in the S&A shall not detonate.

4B6.5 Drop Test

4B6.5.1 6-ft Drop

a. Purpose. To demonstrate that the explosive in the S&A device will not initiate when dropped from a height of 6 ft and will perform to specification after impact if the effects of the drop are not detectable

b. Condition. The S&A device shall be dropped onto a 1/2 in. thick steel plate from a height of 6 ft. (one drop)

c. Pass/Fail Criteria

1. The explosive in the device shall not initiate as a result of the impact and will be safe to handle.

2. If the effects of the drop are not detectable, the S&A device shall fire and properly propagate.

4B6.5.2 20-ft Drop

a. Purpose. To demonstrate that the explosive in the S&A device will not initiate when dropped from a height of 20 ft and will be safe to handle for subsequent disposal.

b. Condition. The S&A device shall be dropped onto a 1/2 in. thick steel plate from a height of 20 ft. (one drop).

c. Pass/Fail Criteria

1. The explosive in the device shall not initiate as a result of the impact and will be safe to handle.

2. The device shall be safe to handle for subsequent disposal.

3. The device need not be functional following this test.

4B6.6 Barrier Test

a. Purpose. To verify that the S&A barrier will prevent the initiation of subsequent explosive charges in the event of an inadvertent firing of the detonator when the device is in the safe condition

b. Conditions

1. A test unit can be used that duplicates all nominal dimensions (including gaps between explosive components, free volume, and diaphragm thickness) of the operational S&A.

2. The explosive transfer line shall be mated to the test unit for this test.

c. Procedure

1. For Rotating Barriers. Position the test unit rotor 50 degrees or greater from the full safe position.

2. For Sliding Barriers. Position the test unit barrier midway between the safe and the arm position.

3. Temperatures

(a) Fire one test unit at least 10^{o}C above the maximum predicted temperature or +71^{o}C whichever is greater.

(b) Fire one test unit at ambient (approximately 25^{o}C) temperature.

(c) Fire one test unit at least 10^{o}C below the minimum temperature or -54^{o} C whichever is lower.

(d) Temperature conditioning of at least 4 h

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S&A AND EED TEST REQUIREMENTS

is required.

d. Pass/Fail Criteria.

1. S&As that use rotor leads shall not have their rotor leads undergo a low or a high order detonation as the result of the test unit firing.

2. S&As that couple the detonator directly to an external ordnance train shall not have that external ordnance train undergo a low or a high order detonation as the result of the test unit firing.

4B6.7 S&A Firing Test

a. Purpose. To verify that the explosives will fire upon application of a specified current and that the output of the device will initiate a specified explosive train after being subjected to a specified preconditioning

b. Conditions

1. The S&A device shall be fired at ambient, high, and low temperatures.

2. The predicted operating current shall be used. **NOTE:** If the operating current is unknown, the test current of 2 times Bruceton All-Fire of the EED shall be used.

3. With both detonators receiving current simultaneously, test half of the test sample.

4. With the detonators receiving current sequentially to demonstrate complete redundancy, test the remaining half of the test sample. **NOTE**: A minimum of 1 min shall be provided between the sequenced detonators firings.

5. A witness target shall be used to verify successful initiation.

c. Pass/Fail Criteria

1. The S&A explosives shall fire upon application of a specified current.

2. The output of the S&A device shall initiate a specified explosive train after being subjected to a specified preconditioning.

4B6.8 Static Discharge Sensitivity

a. Purpose. To verify the EED can withstand electrostatic discharge without being fired, dudded, or deteriorating in performance

b. Procedure

1. Use the static discharge test shown in Figure 4B6-1.

2. Discharge 25 kV from a 500 pf capacitor applied without series resistor at the test points for a pin-to-case mode. **NOTE:** Pins shall be shorted during testing.

3. Discharge 25 kV from a 500 pf capacitor applied through a 5k ohm resistor at the test points for a pin-to-pin mode. **NOTE:** The method used for steps 2 and 3 shall preclude external arcing.

c. Pass/Fail Criteria. The EED shall not fire, dud, or deteriorate in performance as a result of this test.

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S&A AND EED TEST REQUIREMENTS

4B6.9 Bridgewire Resistance

a. Purpose. To verify the Bridgewire resistance of the component

b. Conditions

1. An accuracy of 2 percent of the true value or better is required.

2. The open circuit voltage of the test equipment shall not exceed one volt.

b. Procedure. Apply a maximum current of 10 milliamps or 10 percent of the no-fire current (as determined by the Bruceton test) whichever is less, and measure the Bridgewire resistance.

c. Pass/Fail Criteria. The Bridgewire resistance shall be in accordance with the applicable specification.

4B6.10 Insulation Resistance

a. Purpose. To determine the extent to which the insulating properties are affected by deterioration influences, heat, moisture, dirt, oxidation, or the loss of volatile materials

b. Conditions

1. Insulation resistance measurements shall be made on an apparatus that is suitable for the characteristics of the component to be measured. Such apparatus include: a megohm bridge, megohm meter, insulation resistance test set, or other suitable apparatus.

2. When special preparations or conditions such as special test fixtures, reconnections, grounding, isolation, low atmospheric pressure, humidity, or immersion in water are required, they shall be specified.

3. The applied test voltage shall be a minimum of 500 Vdc. **NOTE:** For the NASA Standard Initiator (NSI), the potential shall not exceed 250 Vdc and only one 250 Vdc test shall be permitted. All subsequent NSI testing shall be at 50 Vdc.

4. All current carrying components and conductors shall be electrically insulated from each other and system grounded.

5. Unless otherwise specified, the measurement error at the required insulation resistance value shall not exceed 10 percent.

c. Procedure. Perform insulation resistance measurements between the mutually insulated points or between insulated points and ground immediately after a 2-min period of uninterrupted test voltage application.

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S&A AND EED TEST REQUIREMENTS

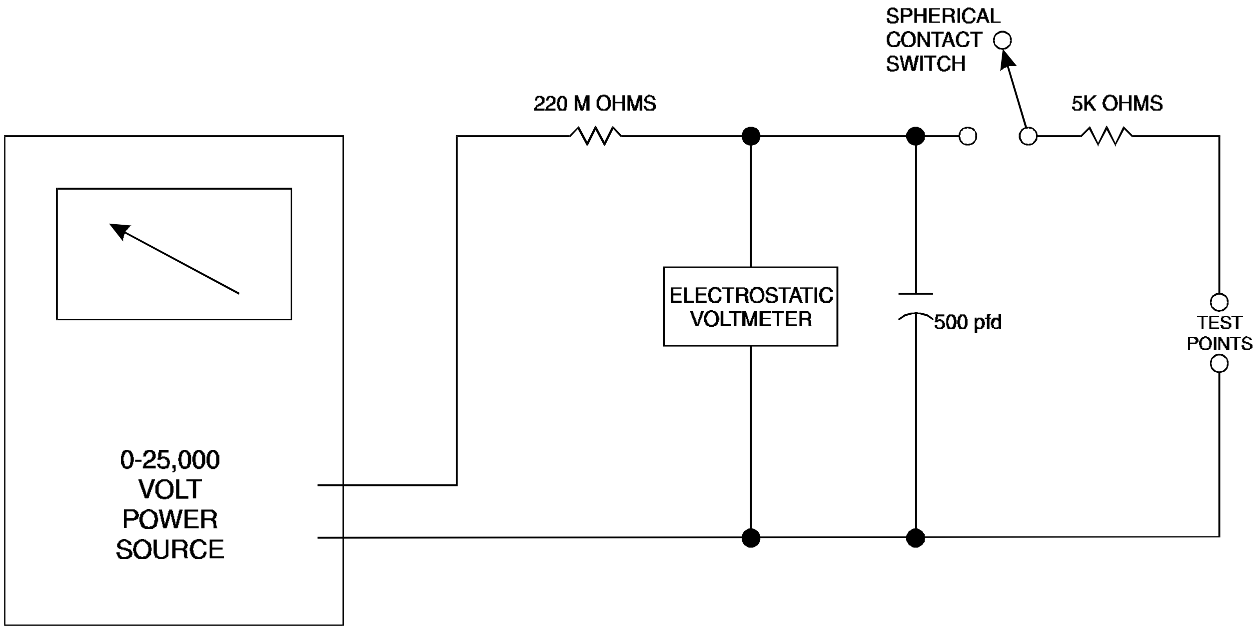

Figure 4B6-1
Static Discharge Test

d. Pass/Fail Criteria. The insulation resistance between all insulated parts shall be greater than 2 megohms after exposure to the environment specified herein.

4B6.11 No-Fire Verification

a. Purpose. To verify that the EED will not fire or degrade when subjected to a no-fire current

b. Conditions. No external heat sinks shall be used for this test.

c. Procedure. Subject the EED to the specified no-fire DC current, +5 percent/-0 percent for 5 min at ambient condition.

d. Pass/Fail Criteria. The EED shall not fire or degrade as a result of this test.

4B6.12 RF Impedance

a. Purpose. To determine the RF impedance of an explosive device. **NOTE**: During a worst-case analysis of the susceptibility of the system to its electromagnetic environment, a worst-case parameter such as the DC resistance is used for the impedance. If this worst-case resistance parameter causes a rejection of the worst-case analysis results, RF impedance can be used to reduce predicted analytical results.

b. Conditions

1. All tests shall be performed at room temperature (approximately 25°C).

2. A minimum of 10 EEDs shall be used in the impedance measurements. These items may be reused in the RF sensitivity or RF dudding testing.

3. Apparatus. The impedance measuring equipment shall be able to function at extremely low RF power levels so that the EEDs are not subjected to heating effects. Automatic equipment is preferred. It is suggested that no more than 1 milliwatt be applied to the EED in any firing mode during the measurements. The mounting apparatus used to connect the EED to the impedance measuring apparatus will be constructed so that the impedance measurements refer to a point as close to the base of the EED (exterior surface of the EED header) as is possible.

d. Procedure

1. Measure impedance for each potential firing mode of the EED. **NOTE 1:** For 2 pin conventional hot wire EEDs, pin-to-pin and pin-to-case impedances shall be measured. **NOTE 2:** For dual Bridgewire EEDs, pin-to-pin, pin-to-case, and bridge-to-bridge firing modes shall be measured.

2. Measure impedances at 10 frequencies between 1 and 1200 MHz inclusive. **NOTE:** The individual measurement frequencies should be

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S&A AND EED TEST REQUIREMENTS

selected so that neighboring frequencies differ from each other by an approximately equal logarithmic increment.

4B6.13 RF Sensitivity

a. Purpose. To determine the radio frequency sensitivity of the EED and to provide an RF no-fire level usable for RF hazard analyses

b. Conditions

1. Number of EEDs Required

(a) Single Bridgewire type: 230 minimum

(b) Dual Bridgewire type: 370 minimum

2. At each radio frequency to be used in the test, the radio frequency power to be applied to the EEDs is determined from the mean DC firing current measured in the Bruceton test and DC Bridgewire resistance. This level shall be applied to the devices in each mode (pin-to-pin, pin-to-case, bridgewire-to-bridgewire).

3. The equipment used in the tests shall provide a means to account for loss in the power supplying system. Applied powers shall be demonstrated to be those that are actually delivered to the input of the EED.

4. Mounting hardware for the EED shall be constructed to allow measurement of power as close to the EED base (exterior surface of the EED header) as possible.

5. The environmental conditions of the Bruceton test shall be complied with.

6. At least 10 frequencies shall be used in the probing tests. These frequencies should be chosen to cover the frequency range from 1 MHz to 32 GHz and should include any frequency corresponding to a known high power density in the EEDs operational environment.

7. Special consideration should be given to the frequencies that correspond to the transmitters that are associated with the overall system of which the EED is a part.

8. If there are no specific requirements, the approximate frequency and modulation stimuli shown in Table 4B6-9 shall be used.

c. Procedure: Probing Test

1. At each test frequency, test 10 EEDs for 5 min in the pin-to-pin mode and 10 EEDs in the pin-to-case mode. If the EED has dual bridgewires, test 10 more in the bridgewire-to-bridgewire mode.

Table 4B6-9
Default Test Frequencies and Modulation

Frequency (MHz)	Modulation
1.5	CW [a]
27.0	CW
154.0	CW
250.0	CW
900.0	CW
2,700.0	P [b]
5,400.0	P
8,900.0	P
15,000.0	CW
32,000.0	P

[a] Continuous Wave

[b] Pulsed modulation with pulse width of 1 microsecond and pulse repetition rate of 1 kHz

2. Up to 5 EEDs that did not fire in the pin-to-pin test can be reused in the pin-to-case test. Thus, RF probing tests require 15 items at each frequency for a two-pin single bridge device and 25 items for a dual bridge device.

d. Analysis

1. Count the number of firings at each frequency. At any particular frequency, if two or less fire, it can be stated with very small risk that the EEDs are less sensitive to the test condition than they are to direct current and the direct current sensitivity level can be used for subsequent analysis. If from 3 to 7 EEDs fire, they can be considered to be of the same order of sensitivity to the test condition as to the direct current susceptibility level and the direct current level can be used in subsequent calculations with a risk of approximately 11 percent. If 8 or more fire, there is little doubt that the EED is more sensitive to the test conditions than to the direct current level.

2. From the data that was obtained in the probing tests, determine the most sensitive frequency/modulation stimulus for each firing mode.

e. Procedure: Determining Statistical RF No-Fire Level

1. Perform a 5-min, 40 item, No-Fire Bruceton test at the most sensitive frequency/ modulation stimulus for each mode. The same equipment shall be used in the probing tests.

2. Forty items are required for each firing mode of the device being tested. Thus, 80 items are required for a two-pin single bridge device and 120 items for a dual bridge device.

APPENDIX 4B6
S&A AND EED TEST REQUIREMENTS

4B6.14 RF Dudding

NOTE: These tests are not required if the EEDs will not be exposed to RF levels greater than the RF no-fire level, as determined by the RF sensitivity testing. The maximum RF exposure level is that maximum level determined by a worst case electromagnetic hazard analysis approved by Range Safety.

a. Purpose. To evaluate the RF dudding susceptibility of the EED in the pin-to-pin firing mode. **NOTE**: Essentially, this evaluation compares DC pulse Bruceton test results for virgin items and for EEDs that are exposed to the 10 percent pin-to-pin firing level (1.2816 Sigma below the mean) as determined in RF sensitivity test.

b. Condition. A total of 120 devices are required if the results of the Bruceton test are available; if not, 165 devices are required. **NOTE**: Since dudding effects can vary with the firing pulse time, this evaluation requires comparison of the Bruceton Data on RF exposed and non-RF exposed groups for two DC pulse times of 5 min and 1 millisec. These are chosen to be long and short, respectively, in relation to the thermal time constant of the EED bridgewire.

c. Procedure

1. Bruceton Tests

(a) Perform the Bruceton test on 40 units using a 5-min DC pulse.

(b) Perform the Bruceton test on a second group of 40 units using a 1 millisec DC pulse.

(c) Expose a third group of 80 virgin EEDs pin-to-pin using the equipment of RF sensitivity test to the 10 percent firing level (probability) as cal-culated from the pin-to-pin RF Bruceton test. This exposure shall be for 5 min. It is expected that several items will fire.

(d) Divide the items remaining from the RF exposure into two approximately equal groups. One group shall be used to rerun the 1 millisec Bruceton described in paragraph *(b)* above; the other group shall be used to rerun the 5 min Bruceton, paragraph *(a)* above.

2. Compare thermal density parameters for virgin and exposed items for both the 1 millisec and 5 min tests. Any large differences in the mean indicate a propensity for RF dudding or possibly RF sensitization.

3. To determine if the RF exposure of the EEDs has altered the DC firing characteristics for either the 5 min or 1 millisec exposure, computes:

$$t_t = \frac{|\overline{LX_C} - \overline{LX_E}|}{(N_C S_C^2 + N_E S_E^2)^{\frac{1}{2}}} \times \left(\frac{N_C N_E (N_C + N_E - 2)}{N_C + N_E} \right)^{\frac{1}{2}}$$

and

$$DF = N_C + N_E - 2$$

WHERE:

$\overline{LX_C}$ = $\log_{10}$ (mean of the control test (amps))

$\overline{LX_E}$ = $\log_{10}$ (mean of the post-exposure test (amps))

N_C = ½ the number of items used in the control test, rounded to the lowest integer

N_E = ½ the number of items used in the post-exposure test, rounded to the lowest integer

S_C^2 = sigma squared for the control test

S_E^2 = sigma squared of the post-exposure test

t_t = tested two tailed value of t for 5 percent probability

DF = degrees of freedom

NOTE: If $N_C = N_E = N$

$$t_t = \frac{|\overline{LX_C} - \overline{LX_E}|}{(S_C^2 + S_E^2)^{\frac{1}{2}}} \times (N - 1)^{\frac{1}{2}}$$

4. Consult Table 4B6-10 and determine the value of t_c (critical two tailed value of t for 5 percent probability) associated with the DF (as computed in paragraph 3, above). If t_t is less than or equal to t_c, one can assume with 95 percent confidence, that the RF exposure has not altered the DC firing characteristics of the devices. The above test is based on a comparison of the mean firing level of the devices as determined by the two Bruceton tests.

APPENDIX 4B6
S&A AND EED TEST REQUIREMENTS

Table 4B6-10
RF Dudding Test Table
Two Tailed Value of T for 5 Percent Probability

DEGREES OF FREEDOM	t_c	DEGREES OF FREEDOM	t_c	DEGREES OF FREEDOM	t_c	DEGREES OF FREEDOM	t_c
1	12.7060	14	2.1450	27	2.0520	39	2.0232
2	4.3030	15	2.1310	28	2.0480	40	2.0211
3	3.1820	16	2.1200	29	2.0450	41	2.0200
4	3.1320	17	2.1100	30	2.0423	42	2.0190
5	2.5760	18	2.1010	31	2.0402	43	2.0179
6	2.4470	19	2.0930	32	2.0381	44	2.0169
7	2.3650	20	2.0860	33	2.0359	45	2.0158
8	2.3060	21	2.0800	34	2.0338	46	2.0148
9	2.2620	22	2.0740	35	2.0317	47	2.0137
10	2.2281	23	2.0690	36	2.0296	48	2.0127
11	2.2010	24	2.0600	37	2.0275	49	2.0116
12	2.1790	25	2.0560	38	2.0253	50	2.0106
13	2.1600	26	2.0540				

4B6.15 All-Fire and No-Fire Bruceton Direct Current Sensitivity

a. Purpose. To determine the pin-to-pin direct current characteristics of EEDs based on an assumed current log normal density function.

b. Conditions

1. A 5-min constant current pulse stimulus is required for determining the maximum no-fire level.

2. A 30-millisecond constant current pulse is required for determining the all-fire level.

3. Forty-five EEDs are required for each test.

4. Test Temperature. The test should be performed under ambient (approximately 25°C) temperature conditions, or operational temperatures if conditions include exposure of the EED to potentially hazardous pin-to-pin stimuli at elevated temperatures. The EED and heat sink intended to simulate actual installation shall be allowed to come to thermal equilibrium at the test temperature before the stimulus is applied to the EED.

5. Heat Sink (as applicable). The heat sink environment of the EED shall approximate the predicted operational thermal environment. If the thermal environments for the EED usage are multiple or unknown, the minimum heat sink should be used during the test. If hazards related to "hand held" environments are to be evaluated, the EED should be mounted in a fixture that effectively insulates the EED against heat transfer to the environment.

6. During testing, each exposure shall be monitored to provide a permanent record (an oscilloscope picture, digital recording on floppy disk, etc.) of the voltage and current of the bridgewire during the five minute pulse. These records shall be retained by the facility performing the test.

7. Test equipment shall be checked for calibration before any data is taken and an estimate made of maximum errors that are possible in pulse amplitudes and durations.

4B6.15.1 No-Fire Procedure

a. Expose 5 units to a constant current pulse for 5 min to determine the mean and Standard Deviation of the firing current assumed log normal density function.

b. Expose 40 units to a constant current pulse for 5 min. **NOTE:** The current pulse amplitudes used for this test are to be chosen so that neighboring tests vary by a logarithmic increment approximately equal (0.5 to 1.25) to the Standard Deviation attained in paragraph *a* above. Improper selection of the mean and standard deviation will cause a failure of the Bruceton test and will require another forty items.

c. In the event of a no-fire, do not disconnect the EED from the system.

1. Apply a current pulse large enough to ensure firing of the EED.

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2. If the EED still fails to fire, omit the no-fire data point from the test, determine the reason for the no-fire, and report in the EED test report. **NOTE:** Any deviation exceeding 10 percent between the fire *(X)* determined sigma and the no fire (0) determined sigma will be sufficient to void the test and be cause for rerun of the test. The difference is computed by the ratio of the larger sigma to the smaller sigma, and a ratio greater than 110 percent will void the test. Tests showing less than four or greater than seven levels shall also be considered void and the test shall be rerun.

d. Compute the results of the Bruceton test on both X and 0 data. **NOTE:** The actual computations of the Bruceton results should be performed by a computer program that is capable of demonstrating its accuracy by calculating log normal density function parameters from simulated Bruceton procedure test results. These simulated results shall be consistent with an assumed log normal density function. This verification, that consists of simulated test results, the assumed distribution parameters, and the Bruceton calculation should be included with the test results.

e. Calculate the confidence levels using the average of the Standard deviations and the average of the means (log) as determined by the X and 0 data.

f. Compute the 0.001 (0.1 percent) firing level of the EED, in amperes with 95 percent confidence, from the Bruceton test results.

4B6.15.2 All-Fire Procedure

The all-fire test shall be conducted following the steps described in the **No-Fire Procedure** section above with the following conditions:

a. Substitute a 30-millisecond constant current pulse in lieu of the 5-min requirement.

b. Compute the 0.999 (99.9 percent) firing level of the EED, in amperes with a 95 percent confidence level from the Bruceton test results.

4B6.16 Firing Test

a. Purpose. To verify that the EED will fire upon application of a specified current after being subjected to a specified preconditioning and to verify that the output of the electroexplosive device meets the requirements of the component specifications.

b. Conditions

1. Gas-producing EEDs shall be fired in a closed bomb. The following parameters shall be measured:

(a) Time from application of current to bridgewire burn out.

(b) Time from application of current to first indication of pressure.

(c) Time from first indication of pressure to peak pressure.

(d) Peak pressure.

2. Detonating explosives shall be tested using a metal witness plate to record output through a dent depth measurement technique.

c. Pass/Fail Criteria. The device shall meet the requirements of the component qualification.

4B6.17 S&A Rotor Lead and Booster Charge Firing Test

a. Purpose

1. To verify that the rotor leads or booster charges will fire when they are subjected to the detonating output of the specified initiating component.

2. To verify that the output of the rotor leads/booster charges meet the requirement of the component specification.

b. Conditions

1. Rotor leads/booster charges shall be stabilized and tested at the test temperatures.

2. A metal witness plate shall be used to record the output by using a dent depth measurement technique to test the rotor lead/booster charge output.

c. Pass/Fail Criteria. The S&A device shall meet the requirements that are specified in the component specification.

4B6.18 High Temperature Storage

a. Purpose. To verify that long term storage at high temperatures will not shorten the service life of an explosive component

b. Condition. The storage conditions shall be +71^{o}C and 40 to 60 percent relative humidity for 30 days.

APPENDIX 4B7
EBW FIRING UNIT AND EBW TEST REQUIREMENTS

Table 4B7-1
EBW Firing Unit Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Product Examination		
Visual	4B1.2.1	100%
Weight	4B1.2.2	100%
Dimension	4B1.2.3	100%
Identification	4B1.2.4	100%
Functional Test *(a)*		
Performance Tests:		
Resistances	4B7.1	100%
Power-on Duty Cycle	4B7.4	100%
Destruct (Fire$^+$) Command	4B7.5	100%
Arm Command	4B7.6	100%
Monitor Functions	4B7.7	100%
Output Pulse	4B7.8	100%
Function Time	4B7.9	100%
H.V. Charge Voltage	4B7.10	100%
Safety Tests:		
H.V. Cap. Discharge Time	4B7.11	100%
Inhibit (Fire^0) Command *(b)*	4B7.12	100%
Output Pulse	4B7.8	100%
Reference Functional Tests *(c)*		
Fire$^+$ Nominal. Voltage	4B7.13	100%
Fire$^+$ Max. Voltage	4B7.14	100%
Fire$^+$ Min. Voltage	4B7.15	100%
Output Pulse	4B7.8	100%
Function Time	4B7.9	100%
H.V. Charge Voltage	4B7.10	100%
Fire^0 Command *(b)*	4B7.12	100%
Operating Environment Tests		
Acoustic *(d)*	4B1.4.2.2	100%
Acceleration	4B1.4.2.3	100%
Thermal Cycling *(e)*	4B1.4.2.4	100%
Thermal Vacuum *(d)*	4B1.4.2.5	100%
Random Vibration *(d)*	4B1.4.2.1	100%
Burn-in	4B1.4.2.6	100%
Leakage *(f)*	4B1.2.7	100%

(a) These tests shall be performed prior to and after all environmental tests.
(b) These tests shall be performed if applicable.
(c) These tests shall be performed after each environmental test.
(d) The EBW FU shall be functionally tested and critical parameters monitored during these environmental tests.
(e) Full functional tests shall be performed at high voltage input on the 1 and 7 cycles, low voltage input on the 2 and 8 cycles, and reference functional tests for the remaining cycles at nominal voltage input.
(f) This test shall be performed after the last operating environment test.

APPENDIX 4B7
EBW FIRING UNIT AND EBW TEST REQUIREMENTS

Table 4B7-2
EBW Firing Unit Qualification Test Matrix
(Page 1 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		1	1	1
Acceptance	ACCEPTANCE TEST MATRIX	X	X	X
Cycle Life	4B7.16	X	X	X
Functional Tests *(a)*				
Performance Tests				
Resistances	4B7.1	X	X	X
Reverse Polarity *(b)*	4B7.2	X	X	X
Overvoltage *(b)*	4B7.3	X	X	X
Power-on Duty Cycle	4B7.4	X	X	X
Destruct ($Fire^+$) Command	4B7.5	X	X	X
Arm Command	4B7.6	X	X	X
Monitor Functions	4B7.7	X	X	X
Output Pulse	4B7.8	X	X	X
Function Time	4B7.9	X	X	X
H.V. Charge Voltage	4B7.10	X	X	X
Safety Tests				
H.V. Cap. Discharge Time	4B7.11	X	X	X
Inhibit ($Fire^0$) Command *(c)*	4B7.12	X	X	X
Output Pulse	4B7.8	X	X	X
Reference Functional Tests *(d)*				
$Fire^+$ Nominal. Voltage	4B7.13	X	X	X
$Fire^+$ Max. Voltage	4B7.14	X	X	X
$Fire^+$ Min. Voltage	4B7.15	X	X	X
Output Pulse	4B7.8	X	X	X
Function Time	4B7.9	X	X	X
H.V. Charge Voltage	4B7.10	X	X	X
$Fire^0$ Command *(c)*	4B7.12	X	X	X
Non-Operating Environment Tests				
Storage Temperature	4B1.3.1	X	X	X
Transport Shock/Bench Handling	4B1.3.3	X	X	X
Transportation Vibration	4B1.3.4	X	X	X
Fungus Resistance	4B1.3.5	X		
Salt Fog	4B1.3.6		X	
Fine Sand	4B1.3.7			X

(a) These tests shall be performed after all non-operating environment tests have been completed; they shall also be performed after all operating environment tests have been completed.
(b) One time test.
(c) These tests shall be performed if applicable.
(d) These tests shall be performed after each environmental test.

APPENDIX 4B7
EBW FIRING UNIT AND EBW TEST REQUIREMENTS

Table 4B7-2
EBW Firing Unit Qualification Test Matrix
(Page 2 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		1	1	1
Operating Environment Tests				
Sinusoidal Vibration *(e)*	4B1.4.1.1	X	X	X
Acoustic *(e)*	4B1.4.1.3	X	X	X
Shock	4B1.4.1.4	X	X	X
Acceleration	4B1.4.1.5	X	X	X
Humidity *(e)*	4B1.4.1.6			X
Thermal Cycling *(f)*	4B1.4.1.7	X	X	X
Thermal Vacuum *(e)*	4B1.4.1.8	X	X	X
Random Vibration *(e)*	4B1.4.1.2	X	X	X
EMI/EMC *(e)*	4B1.4.1.9		X	X
Explosive Atmosphere *(e)*	4B1.4.1.10	X		
Leakage *(g)*	4B1.2.7	X	X	X
Disassembly	4B1.4.1.11	X	X	X

(e) The EBW Firing Unit shall be operated and critical parameters monitored during these environmental tests.

(f) Full functional tests shall be performed at high voltage input on the 1 and 23 cycles, nominal voltage on the 12 and 13 cycles, low voltage input on the 2 and 24 cycles, and reference functional tests for the remaining cycles at nominal voltage input.

(g) This test shall be performed after the last non-operating and the last operating environment test.

APPENDIX 4B7
EBW FIRING UNIT AND EBW TEST REQUIREMENTS

Table 4B7-3
EBW Lot Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Non-Destructive		
Visual Inspection	4B1.2.1	100%
Dimension	4B1.2.2	100%
Static Discharge	4B7.17	100%
Pull Test	4B1.3.8	100%
Bridgewire Continuity	4B7.18	100%
Spark Gap Breakdown	4B7.19	100%
Insulation Resistance	4B7.20	100%
Leakage	4B7.7	100%
X-Ray	4B1.2.5	100%
N-Ray	4B1.2.6	100%
Destructive		
Shock *(a)*	4B1.4.1.4	Lot Sample *(b)*
Thermal Cycling *(a)*	4B1.4.1.7	Lot Sample
High Temp. Storage *(c)*	4B7.25	Lot Sample
Random Vibration *(a)*	4B1.4.1.2	Lot Sample
X-Ray	4B1.2.5	Lot Sample
N-Ray	4B1.2.6	Lot Sample
Bridgewire Continuity	4B7.18	Lot Sample
Spark Gap Breakdown	4B7.19	Lot Sample
Insulation Resistance	4B7.20	Lot Sample
Leakage	4B1.2.7	Lot Sample
No Fire Verification		
125 VAC	4B7.21	Lot Sample
500 Vdc	4B7.21	Lot Sample
Firing Tests:		
Ambient Temperature		
All-Fire Voltage *(d)*	4B7.24	1/6 Lot Sample
Operating Voltage *(e)*	4B7.24	1/6 Lot Sample
High Temperature *(f)*		
All-Fire Voltage *(d)*	4B7.24	1/6 Lot Sample
Operating Voltage *(e)*	4B7.24	1/6 Lot Sample
Low Temperature *(g)*		
All-Fire Voltage *(d)*	4B7.24	1/6 Lot Sample
Operating Voltage *(e)*	4B7.24	1/6 Lot Sample

(a) Environmental tests shall be performed at qualification levels.
(b) Lot Sample is 10 percent of lot but not less than 30 units.
(c) This test is optional. If performed, the lot has initial service life of three years.
(d) All-Fire voltage is specified All-Fire voltage vs Bruceton All-Fire voltage.
(e) In event that operating voltage cannot be predicted the test voltage shall be 2 times Bruceton All-Fire Voltage.
(f) Fire at designed high temperature or +71°C whichever is higher.
(g) Fire at designed low temperature or -54°C whichever is lower.

APPENDIX 4B7
EBW FIRING UNIT AND EBW TEST REQUIREMENTS

Table 4B7-4
EBW Qualification Test Matrix
(Page 1 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED								
		5	230	45	5	5	6	5	5	105
Acceptance (Non-Destructive Test)	ACCEPTANCE TEST MATRIX	X	X	X	X	X	X	X	X	X
RF Sensitivity	4B7.22		$\underline{X}$ *(a)*							
All-Fire Bruceton	4B7.23			$\underline{X}$						
Non-Operating Environment Tests										
Storage Temperature	4B1.3.1								X	X
Trans. Shock/Bench	4B1.3.3								X	X
Hndlg.	4B1.3.4									X
Trans. Vibration	4B1.3.5	X								
Fungus Resistance	4B1.3.6	X								
Salt Fog	4B1.3.7	X								
Fine Sand										
Operating Environment Tests:										
High Temp. Exposure	4B1.3.2				$\underline{X}$					
Shock	4B1.4.1.4								X	X
Acceleration	4B1.4.1.5								X	X
Thermal Cycling	4B1.4.1.6							X	X	X
High Temp. Storage *(b)*	4B7.25									30
Random Vibration	4B1.4.1.2									X
Drop Test (6 Foot)	4B1.3.9								X	X
Drop Test (40 Foot)	4B1.3.10					$\underline{X}$				
Bridgewire continuity	4B7.18							X	X	
Spark Gap Breakdown	4B7.19							$\underline{X}$	$\underline{X}$	$\underline{X}$
Insulation Resistance	4B7.20							$\underline{X}$	$\underline{X}$	$\underline{X}$
Leakage *(c)*	4B1.2.7							$\underline{X}$	$\underline{X}$	$\underline{X}$
X-Ray	4B1.2.5							$\underline{X}$	$\underline{X}$	$\underline{X}$
N-Ray	4B1.2.6							$\underline{X}$	$\underline{X}$	$\underline{X}$
No Fire Verification Tests:										
125 VAC	4B7.21						X	X	X	X
230 VAC	4B7.21	$\underline{X}$								
500 Vdc	4B7.21						X	X	X	X

(a) Underlining indicates units are considered destroyed.
(b) This test is optional. If performed, the lot has initial service life of 3 yr.
(c) This test shall be performed after the last non-operating and the last operating environment test.

APPENDIX 4B7
EBW FIRING UNIT AND EBW TEST REQUIREMENTS

Table 4B7-4
EBW Qualification Test Matrix
(Page 2 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED								
		5	230	45	5	5	6	5	5	105
Firing Tests:										
Ambient Temperature										
All-Fire Voltage *(d)*	4B7.24						X	X	X	
Ambient Temperature										
All-Fire Voltage *(d)*	4B7.24									15
Operating Voltage *(e)*	4B7.24									15
2x Operating Voltage	4B7.24									5
High Temperature *(f)*										
All-Fire Voltage *(d)*	4B7.24									15
Operating Voltage *(e)*	4B7.24									15
2x Operating Voltage	4B7.24									5
Low Temperature *(g)*										
All-Fire Voltage *(d)*	4B7.24									15
Operating Voltage *(e)*	4B7.24									15
2x Operating Voltage	4B7.24									5

(d) All-Fire voltage is specified All-Fire voltage vs Bruceton All-Fire Voltage.

(e) In the event that operating voltage cannot be predicted, the test voltage shall be 2 times Bruceton All-Fire Voltage.

(f) Fire at predicted high temperature or +71°C whichever is higher.

(g) Fire at predicted low temperature or -54°C whichever is lower.

APPENDIX 4B7
EBW FIRING UNIT AND EBW TEST REQUIREMENTS

Table 4B7-5
EBW Aging Surveillance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED	
		5 *(a)*	10 *(b)*
Non-Destructive Tests			
Visual Inspection	4B1.2.1	X	X
Dimension	4B1.2.3	X	X
Static Discharge	4B7.17	X	X
Bridgewire Continuity	4B7.18	X	X
Spark Gap Breakdown	4B7.19	X	X
Insulation Resistance	4B7.20	X	X
Leakage	4B1.2.7	X	X
X-Ray	4B1.2.5	X	X
N-Ray	4B1.2.6	X	X
Destructive Tests			
Shock *(c)*	4B1.4.1.4	X	X
Thermal Cycling *(c)*	4B1.4.1.7	X	X
High Temperature Storage	4B7.25		X
Random Vibration *(c)*	4B1.4.1.2	X	X
X-Ray	4B1.2.5	X	X
N-Ray	4B1.2.6	X	X
Bridgewire Continuity	4B7.18	X	X
Spark Gap Breakdown	4B7.19	X	X
Insulation Resistance	4B7.20	X	X
Leakage	4B1.2.7	X	X
No Fire Verification			
125 VAC	4B7.21	X	X
500 Vdc	4B7.21	X	X
Ambient Temperature Firing			
All-Fire Voltage *(d)*	4B7.24	1	4
High Temperature Firing *(e)*			
All-Fire Voltage *(d)*	4B7.24	2	3
Low Temperature Firing *(f)*			
All-Fire Voltage *(d)*	4B7.24	2	3

(a) Testing that can be conducted to extend service life for one year.
(b) Testing that can be conducted to extend service life for three years.
(c) Environmental tests shall be performed at qualification levels.
(d) All-Fire voltage is specified All-Fire voltage vs Bruceton All-Fire voltage.
(e) Fire at predicted high temperature or +71°C whichever is higher.
(f) Fire at predicted low temperature or -54°C whichever is lower.

APPENDIX 4B7
EBW FIRING UNIT AND EBW TEST REQUIREMENTS

4B7.1 Resistances

a. Verify the EBW-Firing Unit (FU) isolation, insulation, and grounding resistances between case ground and all power leads, outputs, including returns, and between power leads and signal leads, including returns.

b. Measure all external parts of the unit to verify that they are at case ground potential.

4B7.2 Reverse Polarity Protection

Verify that the EBW-FU will not be damaged, have a permanent deterioration of performance, or issue an outputting command when it is subjected to the reversal of the input voltage for a period of 5 min.

4B7.3 Overvoltage Protection

Verify that the EBW-FU will not be damaged when it is subjected to the application of up to 45 Vdc or the OCV of the power source, whichever is greater, to the power input port for a period not less than 5 min.

4B7.4 Power-on Duty Cycle

Verify that the EBW-FU is capable of operating reliably for a period of not less than 45 min after its power is turned off for less than 2 min.

4B7.5 Destruct (FIRE$^+$) Command

Verify that the current draw of the EBW-FU is within the requirements of the component specification during a destruct command at maximum and minimum input voltages.

4B7.6 Arm Command

Verify that the current draw of the EBW-FU is within the requirements of the component specification during the arm command at maximum and minimum input voltages.

4B7.7 Monitor Functions

Verify that all of the required monitor signals are within the component specification.

4B7.8 Output Pulse

Verify that the destruct output pulse is within the requirements of the component specification when it is subjected to either low and high input voltage at the FIRE$^+$ command.

4B7.9 Function Time

Verify that the firing unit responds to the FIRE$^+$ command and that the firing unit outputs the required pulse within the requirements of the component specification.

4B7.10 HV Charge Voltage

Verify that the high voltage capacitor final charge is within the requirements of the component specification when it is subjected to either a low or a high arming input voltage.

4B7.11 HV Capacitor Discharge Time

Verify that the high voltage capacitor will discharge to the specific final voltage within the specified time.

4B7.12 Inhibit (F^0) Command

Verify that the firing unit will not produce an output with an inhibit command voltage present.

4B7.13 FIRE$^+$ Nominal Voltage

Verify that the current draw of the EBW-FU is within the requirements of the component specification during a destruct command when a nominal input voltage is applied at the FIRE$^+$ command.

4B7.14 FIRE$^+$ Maximum Voltage

Verify that the current draw of the EBW-FU is within the requirements of the component specification during a destruct command when a maximum input voltage is applied at the FIRE$^+$ command.

4B7.15 FIRE$^+$ Minimum Voltage

Verify that the current draw of the EBW-FU is within the requirements of the component specification during a destruct command when a minimum input voltage is applied at the FIRE$^+$ command.

4B7.16 Cycle Life

Verify that the firing unit is capable of meeting its required performance at the end of 1000 firing minimum.

4B7.17 Static Discharge Sensitivity

a. Purpose. To verify that the EBW can withstand electrostatic discharge without being fired,

APPENDIX 4B7
EBW FIRING UNIT AND EBW TEST REQUIREMENTS

dudded, or deteriorating in performance.

b. Procedure

1. Use the static discharge test shown in Figure 4B7-1.

2. For a pin-to-case test mode, discharge 25 kV from a 500 picofarad (pf) capacitor that is applied without a series resistor at the test points. **NOTE:** Pins shall be shorted during this test.

3. For a pin-to-pin test, discharge 25 kV from a 500 pf capacitor that is applied through a 5 k ohm resistor at the test points.

NOTE: The method used for *2* and *3* above shall preclude external arcing.

c. Pass/Fail Criteria. The EBW shall not fire, dud, or deteriorate in performance as a result of this test.

4B7.18 Bridgewire Continuity (Grid Dip)

Bridgewire continuity tests using the grid dip test shall be used on EBWs instead of resistance measurement.

4B7.19 Gap Breakdown

Perform EBW gap breakdown voltage tests to verify compliance with the component specification.

4B7.20 Insulation Resistance

a. Purpose. To determine the extent to which the insulating properties are affected by deterioration influences, heat, moisture, dirt, oxidation, or the loss of volatile materials

b. Conditions

1. Insulation resistance measurements shall be made on an apparatus that is suitable for the characteristics of the component to be measured. Such apparatus include: a megohm bridge, megohm meter, insulation resistance test set, or other suitable apparatus.

2. When special preparations or conditions such as special test fixtures, reconnections, grounding, isolation, low atmospheric pressure, humidity, or immersion in water are required, they shall be specified.

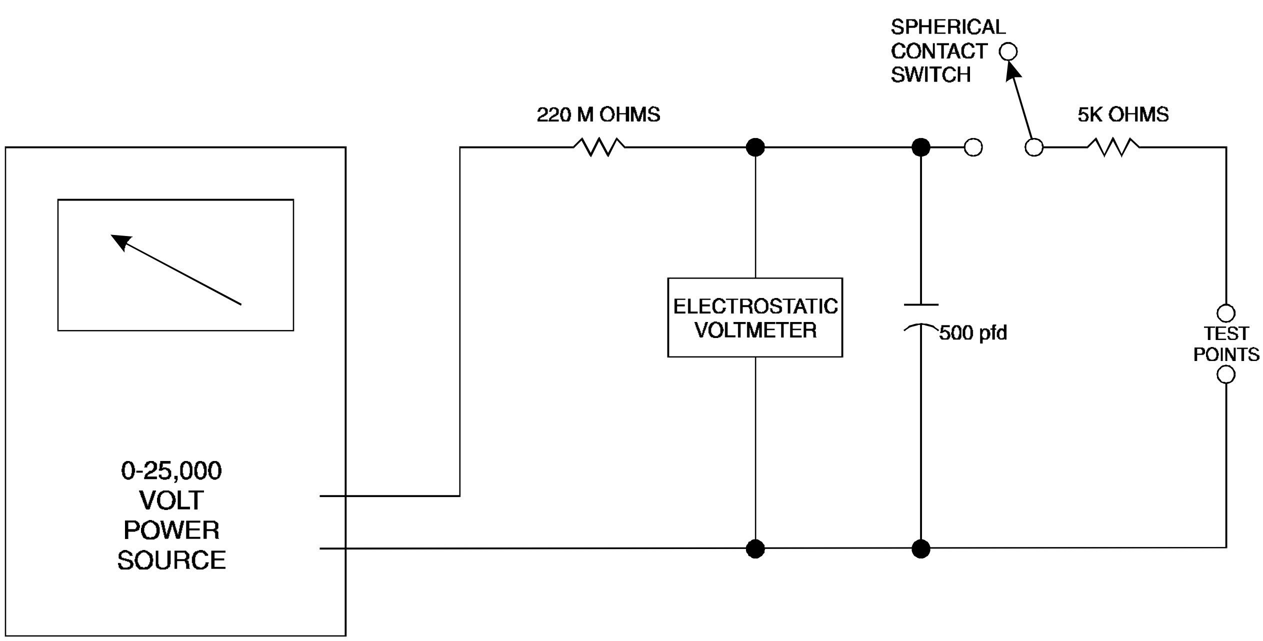

Figure 4B7-1
Static Discharge Test Circuit

APPENDIX 4B7
EBW FIRING UNIT AND EBW TEST REQUIREMENTS

3. The applied test voltage shall be a minimum of 500 Vdc.

4. All current carrying components and conductors shall be electrically insulated from each other and system grounded.

5. Unless otherwise specified, the measurement error at the required insulation resistance value shall not exceed 10 percent.

c. Procedure. Perform insulation resistance measurements between the mutually insulated points or between insulated points and ground immediately after a 2-min period of uninterrupted test voltage application.

d. Pass/Fail Criteria. The insulation resistance between all insulated parts, at a potential of 500 Vdc, shall be greater than 2 megohms after exposure to the environment specified herein.

4B7.21 No-Fire Verification

Verify that the EBW will not fire or degrade when subjected to the following voltages:

a. 125 VAC - Subject the EBW to 125 ±5 Vrms at 60 Hz for 5 min. Apply the voltage across the terminals and between the terminal and the body.

b. 230 VAC - Subject the EBW to 230 ±10 Vrms at 60 Hz for 5 min. Apply the voltage across the terminals and between the terminals and the body.

c. 500 Vdc - Subject the EBW to 500 ±25 Vdc, for 60 sec, that is discharged from a 1 ±10 percent microfarad capacitor. Apply the voltage across the terminals and between the terminals and the body.

4B7.22 RF Sensitivity

To verify that exposure to 1.0 W of absorbed power over a wide range of frequencies as specified in the Table 4B7-6 will not fire or degrade the EBW detonators. The frequency shall be applied across the input terminals of the EBW for 5 sec.

Table 4B7-6
RF Sensitivity

Frequency (MHz)	Type
5 - 100	CW [a]
250 - 300	CW
400 - 500	CW
800 - 1000	CW
2000 - 2400	CW
2900 - 3100	CW
5000 - 6000	CW
9800 - 10000	CW
16000 - 23000	P [b]
32000 - 40000	P

[a] Continuous Wave
[b] Pulse repetition frequency shall not be less than 100 Hz and the pulse width shall be a minimum of 1 microsecond.

4B7.23 All-Fire/No-Fire Bruceton for EBW

a. Purpose. To determine pin-to-pin voltage characteristics of EBWs based on an assumed voltage log normal density function.

b. Conditions

1. A 5-min constant voltage pulse stimulus is required for determining the maximum no-fire level.

2. A 30-millisec constant voltage pulse is required for determining the all-fire level.

3. Forty-five EBWs are required for each test.

4. Test Temperature. The test should be performed under ambient (approximately 25^{o}C) temperature conditions, or operational temperatures if conditions include exposure of the EBW to potentially hazardous pin-to-pin stimuli at elevated temperatures. The EBW and heat sink intended to simulate actual installation shall be allowed to come to thermal equilibrium at the test temperature before the stimulus is applied to the EBW.

5. Heat Sink (as applicable). The heat sink environment of the EBW shall approximate the predicted operational thermal environment. If the thermal environments for the EBW usage are multiple or unknown, the minimum heat sinking should be used during the test. If hazards related to “hand held” environments are to be evaluated, the EBW should be mounted in a fixture that effectively insulates the EBW against heat transfer to the environment.

6. During testing, each exposure shall be monitored to provide a permanent record (an oscilloscope picture, digital recording on floppy disk) of the voltage and current of the bridgewire during the 5-min pulse. These records shall be retained by the facility performing the test.

7. Test equipment shall be checked for calibration before any data is taken and an estimate made of maximum errors that are possible in pulse amplitudes and durations.

APPENDIX 4B7
EBW FIRING UNIT AND EBW TEST REQUIREMENTS

4B7.23.1 No-Fire Procedure

a. Expose 5 units to a constant voltage pulse for 5 min to determine the mean and Standard Deviation of the firing voltage assumed log normal density function.

b. Expose 40 units to a constant voltage pulse for 5 min. **NOTE:** The voltage pulse amplitudes used for this test are chosen so that neighboring tests vary by a logarithmic increment approximately equal (0.5 to 1.25) to the Standard Deviation obtained in paragraph *a* above. Improper selection of the mean and Standard Deviation will cause a failure of the Bruceton test and will require another 40 items.

c. In the event of a no-fire, do not disconnect the EBW from the system.

(1) Apply a voltage pulse large enough to ensure firing of the EBW.

(2) If the EBW still fails to fire, omit the no-fire data point from the test, determine the reason for the no-fire, and report it in the test report.

NOTE: Any deviation exceeding 10 percent between the fire *(X)* determined sigma and the no fire (0) determined sigma will be sufficient to void the test and be cause for rerun of the test. The difference is computed by the ratio of the larger sigma to the smaller sigma, and a ratio greater than 110 percent will void the test. Tests showing less than four or greater than seven levels shall also be considered void and the test shall be rerun.

d. Compute the results of the Bruceton test on both X and 0 data. **NOTE:** The actual computations of the Bruceton results should be performed by a computer program that is capable of demonstrating its accuracy by calculating log normal density function parameters from simulated Bruceton procedure test results. These simulated results shall be consistent with an assumed log normal density function. This verification, that consists of simulated test results, the assumed distribution parameters and the Bruceton calculation, should be included with the test results.

e Calculate the confidence levels using the average of the Standard Deviations and the average of the means (log) as determined by the X and 0 data.

f. Compute the 0.001 (0.1%) firing level of the EBW, in volts with 95 percent confidence, from the Bruceton test results.

4B7.23.2 All-Fire Procedure

The all-fire test shall be conducted following the steps described in the **No-Fire Procedure** section above with the following conditions:

a. Substitute a 30-millisecond constant voltage pulse in lieu of the 5-min requirement.

b. Compute the 0.999 (99.9 percent) firing level of the EBW in volts with a 95 percent confidence level from the Bruceton results.

4B7.24 EBW Firing Test

a. Purpose. To verify that the EBW will fire upon application of a specified voltage after being subjected to a specified preconditioning and to verify that the output of the electroexplosive device meets the requirements of the component specifications

b. Condition. Detonating explosives shall be tested using a metal witness plate to record output through a dent depth measurement technique.

4B7.25 High Temperature Storage

a. Purpose. To verify that long term storage at high temperatures will not shorten the service life of an explosive component.

b. Condition. The storage conditions shall be +71^{o}C and 40-60 percent relative humidity for 30 days.

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LASER INITIATED ORDNANCE SYSTEM TEST REQUIREMENTS

Table 4B8-1
Laser Firing Unit Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Product Examination		
Visual	4B1.2.1	100%
Weight	4B1.2.2	100%
Dimension	4B1.2.3	100%
Identification	4B1.2.4	100%
Functional Test *(a)*		
Performance Tests:		
Resistances	4B8.1	100%
Power-on Duty Cycle	4B8.4	100%
Destruct Command	4B8.5	100%
Arm Command	4B8.6	100%
Monitor Functions	4B8.7	100%
Output Pulse	4B8.8	100%
Function Time	4B8.9	100%
TBD Tests *(b)*	- - -	- -
Safety Test:		
Inhibit Command	4B8.10	100%
Output Pulse	4B8.8	100%
TBD Tests *(b)*	- - -	- -
Reference Functional Test: *(c)*		
Destruct Command Nominal Voltage	4B8.11	100%
Destruct Command Maximum Voltage	4B8.12	100%
Destruct Command Minimum Voltage	4B8.13	100%
Output Pulse	4B8.8	100%
Function Time	4B8.9	100%
Inhibit Command	4B8.10	100%
TBD Tests *(b)*	- - -	- -
Operating Environment Tests:		
Acoustic *(d)*	4B1.4.2.2	100%
Acceleration	4B1.4.2.3	100%
Thermal Cycling *(e)*	4B1.4.2.4	100%
Thermal Vacuum *(d)*	4B1.4.2.5	100%
Random Vibration *(d)*	4B1.4.2.1	100%
Burn-in	4B1.4.2.6	100%
Leakage *(f)*	4B1.2.7	100%

(a) These tests shall be performed prior to and after all environmental tests.
(b) These tests will be established by Range Safety after reviewing and approving the Laser Firing Unit conceptual design.
(c) These tests shall be performed after each environmental test.
(d) The Laser Firing Unit shall be functioned and critical parameters monitored during these environmental tests.
(e) Full functional tests shall be performed at high voltage input on the 1 and 7 cycles, low voltage input on the 2 and 8 cycles, and reference functional tests for the remaining cycles at nominal voltage input.
(f) This test shall be performed after the last operating environment test.

APPENDIX 4B8
LASER INITIATED ORDNANCE SYSTEM TEST REQUIREMENTS

Table 4B8-2
Laser Firing Unit Qualification Test Matrix
(Page 1 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		1	1	1
Acceptance	ACCEPTANCE TEST MATRIX	X	X	X
Cycle Life	4B8.14	X	X	X
Functional Tests *(a)*				
Performance Tests:				
Resistances	4B8.1	X	X	X
Reverse Polarity *(b)*	4B8.2	X	X	X
Overvoltage *(b)*	4B8.3	X	X	X
Power-on Duty Cycle	4B8.4	X	X	X
Destruct Command	4B8.5	X	X	X
Arm Command	4B8.6	X	X	X
Monitor Functions	4B8.7	X	X	X
Output Pulse	4B8.8	X	X	X
Function Time	4B8.9	X	X	X
TBD Tests *(c)*	- - -	-	-	-
Safety Tests:				
Inhibit Command	4B8.10	X	X	X
Output Pulse	4B8.8	X	X	X
TBD Tests *(c)*	- - -	-	-	-
Reference Functional Tests *(d)*				
Destruct Command Nominal Voltage	4B8.11	X	X	X
Destruct Command Maximum Voltage	4B8.12	X	X	X
Destruct Command Minimum Voltage	4B8.13	X	X	X
Output Pulse	4B8.8	X	X	X
Function Time	4B8.9	X	X	X
Inhibit Command	4B8.10	X	X	X
TBD Tests *(c)*	- - -	-	-	-
Non-Operating Environment Tests:				
Storage Temperature	4B1.3.1	X	X	X
Transport Shock/Bench Handling	4B1.3.3	X	X	X
Transportation Vibration	4B1.3.4	X	X	X
Fungus Resistance	4B1.3.5	X		
Salt Fog	4B1.3.6		X	
Fine Sand	4B1.3.7			X

(a) These tests shall be performed after all non-operating environment tests have been completed. These tests shall also be performed after all operating environment tests have been completed.
(b) One time test
(c) These tests will be established by Range Safety after reviewing and approving the Laser Firing Unit conceptual design.
(d) These tests shall be performed after each environmental test.

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LASER INITIATED ORDNANCE SYSTEM TEST REQUIREMENTS

Table 4B8-2
Laser Firing Unit Qualification Test Matrix
(2 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		1	1	1
Operating Environment Tests				
Sinusoidal Vibration *(e)*	4B1.4.1.1	X	X	X
Acoustic *(e)*	4B1.4.1.3	X	X	X
Shock	4B1.4.1.4	X	X	X
Acceleration	4B1.4.1.5	X	X	X
Humidity *(e)*	4B1.4.1.6			X
Thermal Cycling *(f)*	4B1.4.1.7	X	X	X
Thermal Vacuum *(e)*	4B1.4.1.8	X	X	X
Random Vibration *(e)*	4B1.4.1.2	X	X	X
EMI/EMC *(e)*	4B1.4.1.9		X	X
Explosive Atmosphere *(e)*	4B1.4.1.10	X		
TBD Tests *(c)*	- - -	X	X	X
Leakage *(g)*	4B1.2.7	X	X	X
Disassembly	4B1.4.1.11	X	X	X

(c) These tests will be established by Range Safety after reviewing and approving the Laser Firing Unit conceptual design.

(e) The Laser Firing Unit shall be functioned and critical parameters monitored during these environmental tests.

(f) Full functional tests shall be performed at high voltage input on the 1 and 23 cycles, nominal voltage on the 12 and 13 cycles, low voltage input on the 2 and 24 cycles and reference functional tests for the remaining cycles at nominal voltage input.

(g) This test shall be performed after the last non-operating and the last operating environment test.

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LASER INITIATED ORDNANCE SYSTEM TEST REQUIREMENTS

Table 4B8-3
Optical S&A Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Product Examination		
Visual	4B1.2.1	100%
Weight	4B1.2.2	100%
Dimension	4B1.2.3	100%
Identification	4B1.2.4	100%
Functional Test *(a)*		
Full Bench Test *(b)*	4B8.15	100%
Reference Functional Test *(c)*		
Limited Bench Test *(b)*	4B8.16	100%
Operating Environment Tests:		
Thermal Cycling	4B1.4.2.4	100%
Random Vibration *(d)*	4B1.4.2.1	100%
Leakage *(e)*	4B1.2.7	100%

(a) These tests shall be performed prior to and after all environmental tests.
(b) These tests will be established by Range Safety after reviewing and approving the optical S&A conceptual design.
(c) This test shall be performed prior to the random vibration test.
(d) During random vibration testing, the following S&A parameters shall be monitored continuously: arm/safe, barriers locked/unlocked, main laser power connected/disconnected and continuity of optical firing line.
(e) This test shall be performed after the last operating environment test.

APPENDIX 4B8
LASER INITIATED ORDNANCE SYSTEM TEST REQUIREMENTS

Table 4B8-4
Optical S&A Qualification Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED 1	QUANTITY TESTED 2
Acceptance	ACCEPTANCE TEST MATRIX	X	X
Functional Test *(a)*			
Full Bench Test *(b)*	4B8.15	X	X
Reference Functional Test *(c)*			
Limited Bench Test *(b)*	4B8.16	X	X
Non-Operating Environment Tests			
Storage Temperature	4B1.3.1	X	X
Transport Shock/Bench Handling	4B1.3.3	X	X
Transportation Vibration	4B1.3.4	X	X
Fungus Resistance	4B1.3.5	X	
Salt Fog	4B1.3.6	X	
Fine Sand	4B1.3.7	X	
Operating Environment Tests:			
Sinusoidal Vibration *(d)*	4B1.4.1.1	X	X
Shock *(d)*	4B1.4.1.4	X	X
Acceleration	4B1.4.1.5	X	X
Humidity	4B1.4.1.6	X	X
Thermal Cycling	4B1.4.1.7	X	X
Random Vibration *(d)*	4B1.4.1.2	X	X
Explosive Atmosphere	4B1.4.1.10	X	
Leakage *(e)*	4B1.2.7	X	X
Firing Test at Operating Energy *(f)*			
At Ambient Temperature	4B8.21	X	X
At High Temperature *(g)*	4B8.21	X	X
At Low Temperature *(h)*	4B8.21	X	X
Safety Tests			
Cycle life	4B8.17	X	
Stall	4B8.18	X	
Barrier Tests	4B8.20		X
Disassembly	4B1.4.2.7	X	X

(a) These tests shall be performed after all non-operating environment tests have been completed. These tests shall also be performed after all operating environmental tests have been completed.
(b) These tests will be established by Range Safety after reviewing and approving the optical S&A conceptual design.
(c) These tests shall be performed after each environmental test.
(d) During these environmental tests, the following S&A parameters shall be monitored continuously: arm/safe, barriers locked/unlocked, main laser power connected/disconnected and continuity of optical firing line.
(e) This test shall be performed after the last non-operating and the last operating environment test.
(f) In the event that operating energy cannot be predicted, the test energy shall be 2 times their specified operating energy.
(g) Fire at predicted high temperature or +71°C whichever is higher.
(h) Fire at predicted low temperature or -34°C whichever is lower.

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LASER INITIATED ORDNANCE SYSTEM TEST REQUIREMENTS

Table 4B8-5
Ordnance S&A Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Product Examination		
Visual	4B1.2.1	100%
Weight	4B1.2.2	100%
Dimension	4B1.2.3	100%
Identification	4B1.2.4	100%
Functional Test *(a)*		
Full Bench Test	4B8.34	100%
Reference Functional Test *(b)*		
Limited Bench Test	4B8.35	100%
Operating Environment Tests		
Thermal Cycling *(c)*	4B1.4.2.4	100%
Random Vibration *(d)*	4B1.4.2.1	100%
Leakage *(e)*	4B1.2.7	100%

(a) These tests shall be performed prior to and after all environmental tests.
(b) This test shall be performed prior to the random vibration test.
(c) The number of thermal cycles shall be 8 with dwell time of 2 h at each temperature extreme.
(d) During random vibration testing, the S&A ARM/SAFE telemetry circuits and firing line circuits shall be continuously monitored for status.
(e) This test shall be performed after the last operating environment test.

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LASER INITIATED ORDNANCE SYSTEM TEST REQUIREMENTS

Table 4B8-6
Ordnance S&A Qualification Test Matrix
Page 1 of 2

TEST	TEST REQUIREMENT	QUANTITY TESTED			
		1	1	6	3
Acceptance	ACCEPTANCE TEST MATRIX	X	X	X	
Functional Test *(a)*					
Full Bench Test	4B8.34	X		X	
Reference Functional Test *(b)*					
Limited Bench Test	4B8.35	X		X	
Non-Operating Environment Tests					
Storage Temperature	4B1.3.1	X		X	
Transport Shock/Bench Handling	4B1.3.3	X		X	
Transportation Vibration	4B1.3.4	X		X	
Fungus Resistance	4B1.3.5	X			
Salt Fog	4B1.3.6	X			
Fine Sand	4B1.3.7	X			
Operating Environment Tests					
Stall, 5 minutes	4B8.37.1	X		X	
Sinusoidal Vibration *(c)*	4B1.4.1.1	X		X	
Shock *(c)*	4B1.4.1.4	X		X	
Acceleration	4B1.4.1.5	X		X	
Humidity	4B1.4.1.6	X		X	
Thermal Cycling *(d)*	4B1.4.1.7	X		X	
Random Vibration *(c)*	4B1.4.1.2	X		X	
Explosive Atmosphere	4B1.4.1.10	X			
Leakage *(e)*	4B1.2.7	X		X	
Disassembly	4B1.4.1.11			2	
Firing Tests					
At High Temperature *(f)*	4B8.40			2	
At Low Temperature *(g)*	4B8.40			2	

(a) These tests shall be performed after all non-operating environment tests have been completed and also after all operating environment tests have been completed.
(b) These tests shall be performed after each environmental test, excluding leakage, explosive atmosphere, and disassembly.
(c) During these tests, the S&A ARM/SAFE telemetry circuits shall be continuously monitored for status.
(d) The number of thermal cycles shall be 24 with dwell time of 2 h at each temperature extreme.
(e) This test shall be performed after the last non-operating and the last operating environment test
(f) Fire at designed high temperature or +71^{o}C whichever is higher.
(g) Fire at designed low temperature or -54^{o}C whichever is lower.

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LASER INITIATED ORDNANCE SYSTEM TEST REQUIREMENTS

Table 4B8-6
Ordnance S&A Qualification Test Matrix
Page 2 of 2

TEST	TEST REQUIREMENT	QUANTITY TESTED			
		1	1	6	3
Safety Tests					
Cycle life *(h)*	4B8.36	X			
Stall, 60 minutes *(h)*	4B8.37	X			
Six Foot Drop Test *(i)*	4B8.38.1		X		
Twenty Foot Drop Test *(h)*	4B8.38.2	X			
Visual Inspection *(j)*	- - -	X			
Barrier Test *(k)*	4B8.39				X

(h) The S&A exposed to these tests shall not be fired.
(i) A limited bench test shall be performed after this test. Also, the S&A shall be fired at ambient temperature after the limited bench test.
(j) The S&A shall be inspected for hazardous condition prior to disposal.
(k) Test units that duplicate all dimensions, including gaps between explosive components, free volume and diaphragm thickness (if used); of the operational S&A, shall be used. The explosive transfer assemblies that are normally mated to the S&A in flight shall be used.

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LASER INITIATED ORDNANCE SYSTEM TEST REQUIREMENTS

Table 4B8-7
Fiber Optic Cable Assembly Lot Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Non-Destructive Tests		
Visual Inspection	4B1.2.1	100%
Dimension	4B1.2.3	100%
Leakage	4B1.2.7	100%
Pull Test *(a)*	4B1.3.8	100%
X-Ray	4B8.41	100%
Laser Pulse	4B8.22	100%
Optical Continuity	4B8.23	100%
TBD tests *(b)*	- -	- -
Destructive Tests		
Shock *(c)(d)*	4B1.4.1.4	Lot Sample *(e)*
Thermal Cycling *(c)(d)*	4B1.4.1.7	Lot Sample
Random Vibration *(c)(d)*	4B1.4.1.2	Lot Sample
Optical Continuity	4B8.23	Lot Sample
X-Ray	4B1.2.5	Lot Sample
Leakage	4B1.2.7	Lot Sample
Firing Tests: *(f)*		
Ambient Temperature LFU Operating Energy	4B8.29	1/3 Lot Sample
Maximum Predicted High Temperature LFU Operating Energy *(g)*	4B8.29	1/3 Lot Sample
Maximum Predicted Low Temperature LFU Operating Energy *(h)*	4B8.29	1/3 Lot Sample

(a) Pull test shall be performed at 50 lb.
(b) These tests will be established by Range Safety after reviewing and approving the FOCA conceptual design.
(c) Optical continuity shall be monitored continuously during these tests.
(d) Environmental tests shall be performed at qualification level.
(e) Lot Sample is 10 percent or 9 assemblies.
(f) A laser firing unit (LFU) and a pulse catcher capable of measuring output energy shall be connected to the FOCA during these tests. These tests shall demonstrate the FOCAs ability to transmit the required laser energy from the LFU to the pulse catcher at the noted temperature extremes.
(g) Fire at designed high temperature or +71^{o}C whichever is higher.
(h) Fire at designed low temperature or -34^{o}C whichever is lower.

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LASER INITIATED ORDNANCE SYSTEM TEST REQUIREMENTS

Table 4B8-8
Fiber Optic Cable Assembly Qualification Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		10	35	15
Acceptance (Non-Destructive)	ACCEPTANCE TEST MATRIX	X	X	X
Stray Energy Sensitivity	4B8.24		X *(a)*	
Non-Operating Environment Tests				
Storage Temp.	4B1.3.1			X
Trans. Shock	4B1.3.3			X
Trans. Vibration	4B1.3.4			X
Fungus Resistance *(b)*	4B1.3.5			X
Salt Fog *(b)*	4B1.3.6			X
Fine Sand *(b)*	4B1.3.7			X
Operating Environment Tests				
Shock *(c)*	4B1.4.1.4			X
Acceleration	4B1.4.1.5			X
Thermal Cycling *(c)*	4B1.4.1.7			X
Random Vibration *(c)*	4B1.4.1.2			X
Pull Test *(d)(e)*	4B1.3.8			X
Drop Test *(e)*	4B8.19			X
Impact Test *(e)*	4B8.25			X
Bend Test *(e)*	4B8.26			X
Cycle Test *(e)*	4B8.27			X
Mate/Demate *(e)*	4B8.28			X
TBD Test *(f)*	---			---
Leakage *(g)*	4B1.2.7			X
X-Ray	4B1.2.5			X
Firing Tests: *(h)*				
Ambient Temperature 2x Operating Energy	4B8.29			5
High Temperature 2x Operating Energy *(i)*	4B8.29			5
Low Temperature 2x Operating Energy *(j)*	4B8.29			5
Random Vibration/High Temperature Firing LFU Operating Energy *(j)(k)*	4B8.29	5		
Random Vibration/Low Temperature Firing LFU Operating Energy *(j)(k)*	4B8.29	5		

(a) Underlining indicates assemblies are potentially damaged; therefore, the test ends.
(b) Requires only five assemblies for this test.
(c) Optical continuity shall be monitored continuously during these tests.
(d) Pull test shall be performed at 100 Pounds.
(e) Optical continuity shall be performed after the noted tests.
(f) These tests will be established by Range Safety after reviewing and approving the FOCA conceptual design.
(g) This test shall be performed after the last non-operating and the last operating environment test.
(h) A laser firing unit (LFU) and a pulse catcher capable of measuring output energy shall be connected to the FOCA during these tests. These tests shall demonstrate the FOCAs ability to transmit the required laser energy from the LFU to the pulse catcher at the noted temperature extremes.
(i) Fire at designed high temperature or +71^{o}C whichever is higher.
(j) Fire at designed low temperature or -34^{o}C whichever is lower.
(k) During these tests, an LFU and pulse catcher shall be connected to the FOCA (in flight configuration). The FOCA shall be vibrated (qualification level) at the noted temperature and then a laser shall be fired through the FOCA to the pulse catcher.

APPENDIX 4B8
LASER INITIATED ORDNANCE SYSTEM TEST REQUIREMENTS

Table 4B8-9
LID Lot Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Non-Destructive Tests		
Visual Inspection	4B1.2.1	100%
Dimension	4B1.2.3	100%
Leakage	4B1.2.7	100%
Static Discharge	4B8.30	100%
Pull Test *(a)*	4B1.3.8	100%
X-Ray	4B1.2.5	100%
N-Ray	4B1.2.6	100%
Destructive Tests		
Shock *(b)*	4B1.4.1.4	Lot Sample *(c)*
Thermal Cycling *(b) (d)*	4B1.4.1.7	Lot Sample
Random Vibration *(b)*	4B1.4.1.2	Lot Sample
X-Ray	4B1.2.5	Lot Sample
N-Ray	4B1.2.6	Lot Sample
Leakage	4B1.2.7	Lot Sample
No Fire Verification	4B8.31	Lot Sample
Firing Tests		
Ambient Temperature		
All-Fire Energy *(e)*	4B8.33	1/6 Lot Sample
Operating Energy *(f)*	4B8.33	1/6 Lot Sample
Max. Predicted High Temp. *(g)*		
All-Fire Energy *(e)*	4B8.33	1/6 Lot Sample
Operating Energy *(f)*	4B8.33	1/6 Lot Sample
Max. Predicted Low Temp *(h)*		
All-Fire Energy *(e)*	4B8.33	1/6 Lot Sample
Operating Energy *(f)*	4B8.33	1/6 Lot Sample

(a) Pull test shall be performed on LIDs having an integral fiber optic cable (pigtail).
(b) Environmental tests shall be performed at qualification level.
(c) Lot sample is 10 percent of lot but not less than 30 units.
(d) The number of thermal cycles shall be 24 with dwell time of 2 h at each temperature extreme.
(e) All-Fire Energy is specified All-Fire Energy vs. Bruceton All-Fire Energy.
(f) In the event that operating energy cannot be predicted the test energy shall be 2 times Bruceton All-Fire Energy.
(g) Fire at designed high temperature or +71^{o}C whichever is higher.
(h) Fire at designed low temperature or -54^{o}C whichever is lower.

APPENDIX 4B8
LASER INITIATED ORDNANCE SYSTEM TEST REQUIREMENTS

Table 4B8-10
LID Qualification Test Matrix
(Page 1 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED									
		60	315	45	45	5	5	6	5	5	105
Acceptance (Non-Destructive Test)	ACCEPTANCE TEST MATRIX	X	X	X	X	X	X	X	X	X	X
Stray Energy Sensitivity	4B8.24		$\underline{X}$*(a)*								
No Fire Bruceton	4B8.32			$\underline{X}$							
All-Fire Bruceton	4B8.32				$\underline{X}$						
Non-Operating Environment Tests											
Storage Temperature	4B1.3.1									X	X
Trans. Shock/Bench Handling	4B1.3.3									X	X
Trans. Vibration	4B1.3.4										X
Fungus Resistance	4B1.3.5							X			
Salt Fog	4B1.3.6							X			
Fine Sand	4B1.3.7							X			
Operating Environment Tests											
High Temp. Exposure	4B1.3.2					$\underline{X}$					
Shock	4B1.4.1.4									X	X
Acceleration	4B1.4.1.5									X	X
Thermal Cycling *(b)*	4B1.4.1.7								X	X	X
Random Vibration	4B1.4.1.2										X
Pull Test *(c)*	4B1.3.8									X	X
Drop Test (6 ft)	4B1.3.9									X	X
Drop Test (40 ft)	4B1.3.10						$\underline{X}$				
Leakage *(d)*	4B1.2.7								X	X	X
X-Ray	4B1.2.5								X	X	X
N-Ray	4B1.2.6								X	X	X
No Fire Verification	4B8.31	X						X	X	X	X

(a) Underlining indicates units are considered destroyed.
(b) The number of thermal cycles shall be 24 with dwell time of 2 h at each temperature extreme.
(c) Pull tests shall be performed on LIDs having an integral fiber optic cable (pigtail).
(d) This test shall be performed after the last non-operating and the last operating environment test.

APPENDIX 4B8
LASER INITIATED ORDNANCE SYSTEM TEST REQUIREMENTS

Table 4B8-10
LID Qualification Test Matrix
(Page 2 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED									
		60	315	45	45	5	5	6	5	5	105
Firing Tests											
Ambient Temperature											
All-Fire Energy *(e)*	4B8.33							X	X	X	
Ambient Temperature											
All-Fire Energy *(e)*	4B8.33										15
Operating. Energy *(f)*	4B8.33										15
2x Operating. Energy	4B8.33										5
High Temperature *(g)*											
All-Fire Energy *(e)*	4B8.33										15
Operating. Energy *(f)*	4B8.33										15
2x Operating. Energy	4B8.33										5
Low Temperature *(h)*											
All-Fire Energy *(e)*	4B8.33										15
Operating. Energy *(f)*	4B8.33										15
2 x Operating. Energy	4B8.33										5
Random Vibration/High Temperature/Operating Energy *(f)(g)(i)*	4B8.33	30									
Random Vibration/Low Temperature/Operating Energy *(f)(h)(i)*	4B8.33	30									

(e) All-Fire energy is specified All-Fire energy vs Bruceton All-Fire energy.
(f) In the event that operating energy cannot be predicted, the test energy shall be 2 times Bruceton All-Fire Energy.
(g) Fire at designed high temperature or +71^{o}C whichever is higher.
(h) Fire at designed low temperature or -54^{o}C whichever is lower.
(i) During these tests, a fiber optic cable shall be connected to the LIDs in flight configuration. The LIDs shall be vibrated (qualification level) at the noted temperature and then fired.

APPENDIX 4B8
LASER INITIATED ORDNANCE SYSTEM TEST REQUIREMENTS

Table 4B8-11
LID Age Surveillance Test Matrix *(a)*

TEST	TEST REQUIREMENT	QUANTITY TESTED 5
Non-Destructive Tests		
Visual Inspection	4B1.2.1	X
Dimension	4B1.2.3	X
Leakage	4B1.2.7	X
Static Discharge	4B8.30	X
X-Ray	4B1.2.5	X
N-Ray	4B1.2.6	X
Destructive Tests		
Shock *(b)*	4B1.4.1.4	X
Thermal Cycling *(b) (c)*	4B1.4.1.7	X
Random Vibration *(b)*	4B1.4.1.2	X
X-Ray	4B1.2.5	X
N-Ray	4B1.2.6	X
Leakage	4B1.2.7	X
No Fire Verification	4B8.31	X
Firing Test		
Ambient Temperature All-Fire Energy *(d)*	4B8.33	X

(a) Testing shall be conducted one year after lot acceptance testing and each year thereafter to extend service life indefinitely.
(b) Tests shall be performed at qualification levels.
(c) The number of thermal cycles shall be 24 with dwell time of 2 h at each temperature extreme.
(d) All-Fire energy is specified All-Fire energy vs Bruceton All-Fire energy.

APPENDIX 4B8
LASER INITIATED ORDNANCE SYSTEM TEST REQUIREMENTS

4B8.1 Resistances TBD

4B8.2 Reverse Polarity TBD

4B8.3 Overvoltage TBD

4B8.4 Power-on Duty Cycle TBD

4B8.5 Destruct Command TBD

4B8.6 Arm Command TBD

4B8.7 Monitor Functions TBD

4B8.8 Output Pulse TBD

4B8.9 Function Time TBD

4B8.10 Inhibit Command TBD

4B8.11 Destruct Command Nominal Voltage TBD

4B8.12 Destruct Command Maximum Voltage TBD

4B8.13 Destruct Command Minimum Voltage TBD

4B8.14 Cycle Life (LFU) TBD

4B8.15 Full Bench Test TBD

4B8.16 Limited Bench Test TBD

4B8.17 Cycle Life (Optical S&A) TBD

4B8.18 Stall TBD

4B8.19 Drop Test TBD

4B8.20 Barrier Test TBD

4B8.21 Firing Test (Optical S&A) TBD

4B8.22 Laser Pulse TBD

4B8.23 Optical Continuity TBD

4B8.24 Stray Energy Sensitivity TBD

4B8.25 Impact Test TBD

4B8.26 Bend Test TBD

4B8.27 Cycle (FOCA) TBD

4B8.28 Mate/Demate TBD

4B8.29 Firing (FOCA) Test TBD

4B8.30 Static Discharge TBD

4B8.31 No Fire Verification TBD

4B8.32 No Fire/All-Fire Bruceton TBD

4B8.33 Firing (LID) Test TBD

4B8.34 Full Bench Test

a. Purpose

1. To verify that the component is capable of cycling within its specified operating time.

2. To verify the capability to manually safe the component.

3. To confirm the effort that is needed to remove the safing pin and to determine the safing pin retention capability.

b. Procedure

1. Remove the safing pin and measure the force/torque that is required to remove the pin.

2. Cycle the component (SAFE to ARM and ARM to SAFE) 25 more times and measure each cycle time.

3. Remotely arm the component and measure the cycle time.

4. Manually safe the component and measure the angular or the sliding displacement of safe rotation/travel if possible.

5. Verify that the S&A safing pin can be inserted and removed without binding.

6. Install the safing pin.

7. When component is in the SAFE position and the arming current is applied, measure the retention capability of the safing pin.

c. Pass/Failure Criteria. The component shall be capable of operating within the requirements of the component specification.

4B8.35 Limited Bench Test

a. Purpose

1. To verify that the device is capable of cycling within its specified operating time.

2. To verify the capability to manually safe the component.

b. Procedure

1. Cycle the component 5 more times and measure each cycle time (SAFE to ARM and ARM to SAFE).

2. Remotely safe the component.

APPENDIX 4B8
LASER INITIATED ORDNANCE SYSTEM TEST REQUIREMENTS

3. Install the safing pin.

c. Pass/Fail Criteria. The component shall be capable of operating within its specified operating time.

4B8.36 Cycle Life

a. Purpose. To verify that the unit can withstand repeated cycling from the armed to the disarmed position for at least 1000 cycles without any malfunction, failure or deterioration in electromechanical performance.

b. Procedure

1. Cycle the component 1000 times using nominal operational arming voltage.

2. Perform a limited bench test in accordance with the **Limited Bench Test** section of this appendix at every 1/3 interval of cycle time.

c. Pass/Fail Criteria. The component shall be capable of operating within its specified operating time.

4B8.37 Stall

4B8.37.1 5-Min Stall

a. Purpose. To verify that electrically actuated S&As will meet the specified electro-mechanical performance requirements after the application of maximum operational arming voltages continuously for up to 5 min with the safing pin installed

b. Procedure

1. With the safing pin installed, apply a maximum value arming voltage for 5 min.

2. Verify the performance by performing a limited bench in accordance with the **Limited Bench Test** section of this Appendix.

c. Pass/Fail Criteria. The component shall be capable of operating within the requirements of the component specification.

4B8.37.2 60-Min Stall

a. Purpose. To verify that the explosive that is in the S&A will not detonate after the application of maximum operational arming voltages continuously for up to 60 min with the safing pin installed.

b. Procedure. With the safing pin installed, apply a maximum value arming voltage for 60 min.

c. Pass/Fail Criteria. The detonator/explosive in the S&A shall not detonate.

4B8.38 Drop Test

APPENDIX 4B8
LASER INITIATED ORDNANCE SYSTEM TEST REQUIREMENTS

4B8.38.1 6-ft Drop Test

a. Purpose. To demonstrate that the explosive in the S&A device will not initiate when dropped from 6 ft and will perform to specification after impact if the effects of the drop are not detectable

b. Condition. The S&A device shall be dropped onto a 1/2-in. thick steel plate from a height of 6 ft. (one drop)

c. Pass/Fail Criteria

1. The explosive in the device shall not ini-tiate as a result of the impact and will be safe to handle.

2. If the effects of the drop are not detectable, the S&A device shall be required to fire and properly propagate.

4B8.38.2 20-ft Drop Test

a. Purpose. To demonstrate that the explosive in the S&A device will not initiate when dropped from 20 ft and will be safe to handle for subsequent disposal

b. Condition. The S&A device shall be dropped onto a 1/2-in. thick steel plate from a height of 20 ft. (one drop)

c. Pass/Fail Criteria

1. The explosive in the device shall not ini-tiate as a result of the impact and will be safe to handle.

2. The device shall be safe to handle for sub-sequent disposal.

3. The device need not be functional following this test.

4B8.39 Barrier Test

a. Purpose. To verify that the S&A barrier will prevent the initiation of subsequent explosive charges in the event of an inadvertent firing of the detonator when the device is in the safe condition

b. Condition*(s)*

1. A test unit can be used that duplicates all nominal dimensions (including gaps between explosive components, free volume, and diaphragm thickness) of the operational S&A.

2. The explosive transfer line shall be mated to the test unit for this test.

c. Procedure

1. For Rotating Barriers. Position the test unit rotor 50 degrees or greater from the full safe position.

2. For Sliding Barriers. Position the test unit barrier midway between the safe and the arm position.

3. Temperatures.

(a) Fire one test unit at least 10^{o}C above the maximum predicted temperature or +71^{o}C which-ever is greater.

(b) Fire one test unit at ambient (approximately 25^{o}C) temperature.

(c) Fire one test unit at least 10^{o}C below the minimum temperature or -54^{o} C whichever is lower.

(d) Temperature conditioning of at least 4 h is required.

d. Pass/Fail Criteria.

1. S&As that use rotor leads shall not have their rotor leads undergo a low or a high order detonation as the result of the test unit firing.

2. S&As that couple the detonator directly to an external ordnance train shall not have that external ordnance train undergo a low or a high order detonation as the result of the test unit firing.

4B8.40 S&A Firing

a. Purpose. To verify that the explosives will

APPENDIX 4B8
LASER INITIATED ORDNANCE SYSTEM TEST REQUIREMENTS

fire upon application of a specified energy and that the output of the device will initiate a specified explosive train after being subjected to a specified preconditioning

b. Conditions

1. The S&A device shall be fired at ambient, high, and low temperatures.

2. The predicted operating energy shall be used. **NOTE:** If the operating energy is unknown, the test energy of 2 times Bruceton All-Fire of the LID shall be used.

3. With both detonators receiving energy simultaneously, test half of the test sample.

4. With the detonators receiving energy sequentially to demonstrate complete redundancy, test the remaining half of the test sample. **NOTE**: A minimum of 1 min shall be provided between the sequenced detonators firings.

5. A witness target shall be used to verify successful initiation.

c. Pass/Fail Criteria

1. The S&A explosives shall fire upon application of a specified energy.

2. The output of the S&A device shall initiate a specified explosive train after being subjected to a specified preconditioning.

APPENDIX 4B9
ETS AND DESTRUCT CHARGE TEST REQUIREMENTS

Table 4B9-1
ETS and Destruct Charge Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Non-Destructive		
Visual Inspection	4B1.2.1	100%
Dimension	4B1.2.3	100%
Leakage	4B1.2.7	100%
X-Ray	4B1.2.5	100%
N-Ray	4B1.2.6	100%
Destructive		
Pull Test *(a)*	4B1.3.8	Lot Sample*(c)*
Shock *(b)*	4B1.4.1.4	Lot Sample
Thermal Cycling *(b)*	4B1.4.1.7	Lot Sample
High Temp. Storage *(d)*	*(e)*	Lot Sample
Random Vibration *(b)*	4B1.4.1.2	Lot Sample
X-Ray	4B1.2.5	Lot Sample
N-Ray	4B1.2.6	Lot Sample
Leakage	4B1.2.7	Lot Sample
Firing Test *(f)*		
Ambient Temperature	- -	1/3 Lot Sample
High Temperature *(g)*	- -	1/3 Lot Sample
Low Temperature *(h)*	- -	1/3 Lot Sample

(a) The pull test shall be performed at 100 lb for ETS and associated fittings; 50 lb for destruct charge and associated fittings.
(b) Tests shall be performed at qualification level.
(c) The sample size is 10 percent of the lot, but not less than 9 units from the lot.
(d) This test is optional. If performed, the lot has initial service life of three years.
(e) The item shall be subjected to high temperature storage environment as part of an accelerated aging test. The storage conditions shall be +71°C and 40-60 percent relative humidity for 30 days.
(f) Item shall be function against a witness plate.
(g) Fire at designed high temperature or +71°C whichever is higher.
(h) Fire at designed low temperature or -54°C whichever is lower.

APPENDIX 4B9
ETS AND DESTRUCT CHARGE TEST REQUIREMENTS

Table 4B9-2
ETS and Destruct Charge Qualification Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		2	4	21
Acceptance (Non-Destructive)	ACCEPTANCE TEST MATRIX	X	X	X
Non-Operating Environment Test				
Storage Temperature	4B1.3.1		X	
Transport Shock/Bench Handling	4B1.3.3		X	
Transportation Vibration	4B1.3.4		X	
Fungus Resistance	4B1.3.5		X	
Salt Fog	4B1.3.6		X	
Fine Sand	4B1.3.7		X	
Operating Environment Test *(a)*				
Pull Test *(b)*	4B1.3.8		X	X
Sinusoidal Vibration	4B1.4.1.1	X	X	
Shock	4B1.4.1.4			X
Acceleration	4B1.4.1.5			X
Humidity	4B1.4.1.6	X	X	
Thermal Cycling	4B1.4.1.7	X	X	X
High Temperature Storage *(c)*	*(d)*			10
Random Vibration	4B1.4.1.2			X
Drop Test (6 Foot) *(e)*	4B1.3.9	1		
Drop Test (40 Foot) *(f)*	4B1.3.10	1	X	
Leakage *(g)*	4B1.2.7		X	X
X-Ray	4B1.2.5		X	X
N-Ray	4B1.2.6			X
Firing Test *(h)*				
Ambient Temperature	- -			7
High Temperature *(i)*	- -		2	7
Low Temperature *(j)*	- -		2	7

(a) ETS manifold (if used) shall be tested with ETS assembly attached during all operating environment tests.

(b) The pull test shall be performed at 100 lb for ETS and associated fittings, 50 lb for Destruct Charge and associated fittings.

(c) This test is optional. If performed, the lot has initial service life of three years.

(d) The item shall be subject to high temperature storage environment as part of an accelerated aging test. The storage conditions shall be +71°C and 40-60 percent relative humidity for 30 days.

(e) Component is required to function if the effects of the drop test are not detectable.

(f) Component is not required to be functioned after this test.

(g) This test shall be performed after the last non-operating and the last operating environment test.

(h) Item shall be functioned against a witness plate.

(i) Fire at designed high temperature or +71°C whichever is higher.

(j) Fire at designed low temperature or -54°C whichever is lower.

APPENDIX 4B9
ETS AND DESTRUCT CHARGE TEST REQUIREMENTS

Table 4B9-3
ETS and Destruct Charge Age Surveillance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED	
		5 *(a)*	**10** *(b)*
Non-Destructive Tests			
Visual Inspection	4B1.2.1	X	X
Dimension	4B1.2.3	X	X
Leakage	4B1.2.7	X	X
X-Ray	4B1.2.5	X	X
N-Ray	4B1.2.6	X	X
Destructive Tests			
Pull Test *(c)*	4B1.3.8	X	X
Shock	4B1.4.1.4	X	X
Thermal Cycling *(d)*	4B1.4.1.7	X	X
High Temperature Storage	*(e)*		X
Random Vibration *(d)*	4B1.4.1.2	X	X
Leakage	4B1.2.7	X	X
X-Ray	4B1.2.5	X	X
N-Ray	4B1.2.6	X	X
Firing Test *(f)*			
High Temperature *(g)*		3	5
Low Temperature *(h)*		2	5

(a) Testing that can be conducted to extend service life for one year.
(b) Testing shall be conducted to extend service life for three years.
(c) The pull test shall be performed at 100 lb for ETS and associated fittings; 50 lb for destruct charges and associated fittings.
(d) Tests shall be performed at qualification level.
(e) The item shall be subjected to an extreme storage environment as part of an accelerated aging test. The storage conditions shall be +71°C and 40 to 60 percent relative humidity for 30 days.
(f) Item shall be function against a witness plate.
(g) Fire at predicted high temperature or +71°C whichever is higher.
(h) Fire at predicted low temperature or -54°C whichever is lower.

APPENDIX 4B10
PERCUSSION ACTIVATED DEVICE TEST REQUIREMENTS

Table 4B10-1
PAD Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Non-Destructive Tests:		
Visual	4B1.2.1	100%
Dimension	4B1.2.3	100%
Pull Test *(a)*	----	100%
Pin Locking Test *(b)*	----	100%
Pin Insertion/Removal Test *(c)*	----	100%
Pin Retention Test *(d)*	----	100%
Leakage	4B1.2.7	100%
X-Ray	4B1.2.5	100%
N-Ray	4B1.2.6	100%
Destructive Test		
Shock *(e)*	4.B.4.1.4	Lot Sample *(f)*
Thermal Cycling *(e)*	4B1.4.1.7	Lot Sample
Random Vibration *(e)*	4B1.4.1.2	Lot Sample
High Temp. Storage *(g)*	*(h)*	Lot Sample
Leakage	4B1.2.7	Lot Sample
X-Ray	4B1.2.5	Lot Sample
N-Ray	4B1.2.6	Lot Sample
Firing Test at Operation Pull Distance *(i)(j)*		
At Ambient Temperature	----	1/3 of Lot Sample
At High Temperature *(k)*	----	1/3 of Lot Sample
At Low Temperature *(l)*	----	1/3 of Lot Sample

(a) PAD shall be pulled with 50 lb of force. Spring constant and mechanical movement shall be verified.
(b) The PAD shall be pulled to 100 lb with the safing pin installed. The PAD firing assembly shall not show any motion nor experience any mechanical anomalies.
(c) The force required for pin insertion/removal shall be between 20-40 pounds or 20-40 in-lb of torque.
(d) This test places a load test on the PAD lanyard of 50 lb with the safing pin installed. The safing pin shall be subjected to a Insertion/Removal force and shall not disengage from the PAD.
(e) Tests shall be performed at qualification levels.
(f) A lot sample consists of 10% of the lot or 9 units whichever is greater.
(g) This test is optional, if performing, the lot has initial service of 3 years.
(h) The item shall be subjected to high temperature storage environment as part of an accelerated aging test. The storage candidates shall be +71 degrees C and 40 to 60 percent relative humidity for 30 days.
(i) The pull distance shall be measured during this test and verified within acceptable tolerances.
(j) The spring constant shall be measured while pulling the PAD during the firing test.
(k) Fire at designed high temperature or +71 degrees C whichever is higher.
(l) Fire at designed low temperature or -54 degrees C whichever is lower.

APPENDIX 4B10
PERCUSSION ACTIVATED DEVICE TEST REQUIREMENTS

Table 4B10-2
PAD Qualification Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		4	2	21
Acceptance (Non-Destructive Test)	ACCEPTANCE TEST MATRIX	X	X	X
No-Fire Impact Test *(a) (b) (c)*	----			X
Pin Locking Test *(d)*	----	X	X	X
Pin Retention Test *(e)*	----	X	X	X
Non-Operating Environment Tests				
Storage Temperature	4B1.3.1	X		X
Transport Shock/Bench Handling	4B1.3.3	X		X
Transportation Vibration	4B1.3.4	X		X
Fungus Resistance	4B1.3.5	X		
Salt Fog	4B1.3.6	X		
Fine Sand	4B1.3.7	X		
Operating Environment Tests				
Sinusoidal Vibration	4B1.4.1.1	X		X
Shock	4B1.4.1.4	X		X
Acceleration	4B1.4.1.5	X		X
Humidity	4B1.4.1.6	X		
Thermal Cycling	4B1.4.1.7	X		X
High Temperature Storage *(f)*	*(g)*			X
Random Vibration	4B1.4.1.2	X		X
Leakage	4B1.2.7	X		X
N-Ray	4B1.2.5	X		X
X-Ray	4B1.2.6	X		X
Disassembly	4B1.4.1.11	1		3
Firing Test at Operation Pull Distance *(a) (h)*				
At Ambient Temperature	----			6
At High Temperature *(i)*	----	2		6
At Low Temperature *(j)*	----	1		6
Safety Test				
Drop Test (6 Foot)	4B1.3.9		1	
Drop Test (20 Foot) *(k)(l)*	4B1.3.10		1	

(a) The spring constant verification shall be measured while pulling the PAD during the firing test.
(b) This test to be performed using the maximum guaranteed no-fire pull distance (50 lb). The PAD assembly shall be released and the PAD shall not fire. The PAD primer initiation assembly shall not disengage inadvertently when pulled the guaranteed no-fire distance.
(c) PAD No-Fire Bruceton impact energy testing is not required for PADs using a design that prevents impact with the primer unless the firing assembly is pulled to its operational fire distance. **NOTE**: This testing will be performed during the Primer qualification test.
(d) The PAD shall be pulled to 200 lb with the safing pin installed. The PAD firing assembly shall not show any motion nor experience any mechanical anomalies.
(e) This test places a load test on the PAD lanyard of 100 lb with the safing pin installed. The safing pin shall be subjected to twice the Insertion/Removal force and shall not disengage from the PAD.
(f) This test is optional; if performed, the lot has initial service life of 3 years.
(g) The item shall be subjected to high temperature storage environment as part of an accelerated aging test. The storage candidates shall be +71 degrees C and 40 to 60 percent relative humidity for 30 days.
(h) Operational impact energy shall assure 2 times the Bruceton all-fire energy (energy is a function of spring constant and distance calculated from the Bruceton all-fire impact test set). The pull distance shall be measured during this test and verified within acceptable tolerances.
(i) Fire at designed high temperature or +71 degrees C whichever is higher.
(j) Fire at designed low temperature or -54 degrees C whichever is lower.
(k) The PAD exposed to these tests shall not be fired.
(l) The PAD shall be inspected for hazardous condition prior to disposal.

APPENDIX 4B10
PERCUSSION ACTIVATED DEVICE TEST REQUIREMENTS

Table 4B10-3
PAD Primer/Booster/Charge Lot Acceptance Test Matrix

TEST	TEST REQUIREMENTS	QUANTITY TESTED
Non-Destructive Test		
Visual Inspection	4B1.2.1	100%
Dimension	4B1.2.3	100%
Leakage	4B1.2.7	100%
X-Ray.	4B1.2.5	100%
N-Ray	4B1.2.6	100%
Destructive Test		
Shock *(b)*	4B1.4.1.4	Lot Sample *(a)*
Thermal Cycling *(b)*	4B1.4.1.7	Lot Sample
High Temperature Storage *(c)*	*(d)*	Lot Sample
Random Vibration *(b)*	4B1.4.1.2	Lot Sample
Leakage	4B1.2.7	Lot Sample
X-Ray	4B1.2.5	Lot Sample
N-Ray	4B1.2.6	Lot Sample
Firing Tests *(e)*		
Ambient Temperature		
All-Fire Impact Test *(f)*	----	1/6 Lot Sample
Operational Impact Test *(g)*	----	1/6 Lot Sample
High Temperature *(h)*		
All-Fire Impact Test *(f)*	----	1/6 Lot Sample
Operational Impact Test *(g)*	----	1/6 Lot Sample
Low Temperature *(i)*		
All-Fire Impact Test *(f)*	----	1/6 Lot Sample
Operational Impact Test *(g)*	----	1/6 Lot Sample

(a) Lot sample is 10% of lot but not less than 30 units.
(b) Tests shall be performed at qualification levels.
(c) This test is optional; if performed, the lot has initial service life of 3 years.
(d) The item shall be subjected to high temperature storage environment as part of an accelerated aging test. The storage candidates shall be +71 degrees C and 40- to 60 percent relative humidity for 30 days.
(e) Delay time shall be measured from primer impact to ordnance output.
(f) All-Fire is determined by the Bruceton all-fire impact series.
(g) Operational Impact shall be at least 2 times the all-fire impact.
(h) Fire at designed high temperature or +71 degrees C whichever is higher.
(i) Fire at designed low temperature or -54 degrees C whichever is lower.

APPENDIX 4B10
PERCUSSION ACTIVATED DEVICE TEST REQUIREMENTS

Table 4B10-4
PAD Primer/Booster Charge Qualification Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED					
		45	5	6	5	5	105
Acceptance (Non-Destructive Test)	ACCEPTANCE TEST MATRIX	X	X	X	X	X	X
All-Fire Bruceton *(a)*	----	<u>X</u>*(b)*					
High Temp. Exposure	4B1.3.2		<u>X</u>				
Shock	4B1.4.1.4					X	X
Thermal Cycling	4B1.4.1.7				X	X	X
High Temperature Storage *(c)*	*(d)*						30
Random Vibration	4B1.4.1.2						X
Leakage	4B1.2.7				X	X	X
X-Ray	4B1.2.5				X	X	X
N-Ray	4B1.2.6				X	X	X
Firing Tests *(a)(e)*:							
Ambient Temperature							
All-Fire Impact *(f)*	----			<u>X</u>	<u>X</u>	<u>X</u>	
Ambient Temperature							
All-Fire Impact *(f)*	----						<u>15</u>
Operational Impact *(g)*	----						<u>15</u>
2X Operational Impact	----						<u>5</u>
High Temperature *(h)*							
All-Fire Impact *(f)*	----						<u>15</u>
Operational Impact *(g)*	----						<u>15</u>
2X Operational Impact	----						<u>5</u>
Low Temperature *(i)*							
All-Fire Impact *(f)*	----						<u>15</u>
Operational Impact *(g)*	----						<u>15</u>
2X Operational Impact	----						<u>5</u>

(a) These tests shall be performed utilizing primer/booster charge in a test set-up that duplicates the PAD striking assembly (e.g. spring and firing pin).
(b) Underlining indicates units are considered destroyed.
(c) This test is optional; if performed, the lot has initial service life of 3 years.
(d) The item shall be subjected to high temperature storage environment as part of an accelerated aging test. The storage candidates shall be +71 degrees C and 40 to 60 percent relative humidity for 30 days.
(e) Delay time shall be measured from primer impact to ordnance output.
(f) All-Fire is determined by the Bruceton all-fire impact series.
(g) Operational Impact shall be at least 2 times the all-fire impact.
(h) Fire at designed high temperature or +71 degrees C whichever is higher.
(i) Fire at designed low temperature or -54 degrees C whichever is lower.

APPENDIX 4B10
PERCUSSION ACTIVATED DEVICE TEST REQUIREMENTS

Table 4B10-5
PAD and Primer/Booster Charge Aging Surveillance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED	
		5 *(a)*	**10 *(b)***
Non-Destructive Test			
Visual Inspection	4B1.2.1	X	X
Dimension	4B1.2.3	X	X
Leakage	4B1.2.7	X	X
X-Ray	4B1.2.5	X	X
N-Ray	4B1.2.6	X	X
Destructive			
Shock *(c)*	4B1.4.1.4	X	X
Thermal Cycling *(c)*	4B1.4.1.7	X	X
High Temperature Storage	*(d)*		X
Random Vibration *(c)*	4B1.4.1.2	X	X
Leakage	4B1.2.7	X	X
X-Ray	4B1.2.5	X	X
N-Ray	4B1.2.6	X	X
Firing Test: *(e)(f)*			
High Temperature *(g)*			
All-Fire Impact *(h)*	----	3	5
Low Temperature *(i)*			
All-Fire Impact *(h)*	----	2	5

(a) Testing that can be conducted to extend service for one year.
(b) Testing that can be conducted to extend service for three years
(c) Tests shall be performed at qualification levels.
(d) The item shall be subjected to high temperature storage environment as part of an accelerated aging test. The storage candidates shall be +71 degrees C and 40 to 60 percent relative humidity for 30 days.
(e) Delay time shall be measured from primer impact to ordnance output.
(f) These tests shall be performed utilizing primer/booster charge in a test set-up that duplicates the PAD striking assembly (e.g. spring and firing pin).
(g) Fire at designed high temperature or +71 degrees C whichever is higher.
(h) All-Fire is determined by the Bruceton all-fire impact series.
(i) Fire at designed low temperature or -54 degrees C whichever is lower.

APPENDIX 4B11
SHOCK AND VIBRATION ISOLATOR TEST REQUIREMENTS

a. Purpose.

1. To detect material and workmanship defects prior to acceptance of the isolator for flight

2. To ensure each isolator meets the performance criteria as defined in the component specification

b. Procedure

1. Subject each isolator to a sinusoidal vibration in at least one of the principal axes. **NOTE:** If the resonant frequency and amplification factor are different for each axes, subject the isolator to sinusoidal vibration in all 3 axes.

2. The frequency range for the sinusoidal input shall be representative of the MPE of the vehicle.

3. The amplitude for sinusoidal input to each isolator shall be computed as follows:

$$S = \frac{1}{N}\left[\frac{p \times Q \times F_n \times W}{2}\right]^{\frac{1}{2}}$$

WHERE:

S	=	Total sinusoidal input to the isolator system in peak G's.
π	=	3.141
Q	=	Isolator resonant amplification factor (specification value)
F_n	=	Isolator resonant frequency (specification value)
W	=	Power spectrum density value of random input spectrum, MPE at F_n
N	=	Number of isolators used in system

4. Record the resonant frequency *(Fn)* and amplification factor *(Q)* of each isolator.

c. Pass/Fail Criteria. The resonant frequency and amplification factor shall be within the specified limit.

APPENDIX 4B12
TRANSPONDER TEST REQUIREMENTS

Table 4B12-1
Transponder Acceptance Test Matrix
(Page 1 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED
Product Examination		
Visual	4B1.2.1	100%
Weight	4B1.2.2	100%
Dimension	4B1.2.3	100%
Identification	4B1.2.4	100%
Functional Tests *(a)*		
Continuity & Isolation	4B12.1	100%
Time to See (delay timer)	4B12.2	100%
Time to Stabilize	4B12.3	100%
Transmit Frequency	4B12.4	100%
Frequency Drift Rate	4B12.5	100%
Peak Power Output	4B12.7	100%
Pulse Width	4B12.8	100%
Pulse Rise Time	4B12.9	100%
Pulse Fall Time	4B12.10	100%
Pulse Width Jitter	4B12.11	100%
Pulse RF Spectrum (6 dB B/W)	4B12.12	100%
Measured RF Threshold Sensitivity	4B12.13	100%
Receiver Bandwidth (3 dB)	4B12.14	100%
Receiver Bandwidth (40 dB)	4B12.15	100%
Image Rejection	4B12.16	100%
Reply Delay (-55 dBm)	4B12.17	100%
Delay Variation vs Signal Strength (dBm)	4B12.18	100%
Delay Jitter vs Signal Strength (dBm)	4B12.19	100%
Delay Variation vs Freq.(MHz)	4B12.20	100%
Delay Jitter vs Freq. (MHz)	4B12.21	100%
Delay Variation vs PRF (pps)	4B12.22	100%
Delay Jitter vs PRF (pps)	4B12.23	100%
Delay Variation vs Operating Voltage	4B12.24	100%
Delay Jitter vs Operating Voltage	4B12.25	100%
Operating Current vs Oper. Voltages	4B12.26	100%
Decoder Accept Limits	4B12.27	100%
Decoder Reject Limits	4B12.28	100%
Pulse Width Acceptance	4B12.29	100%
Recovery Time (0 dBm)	4B12.30	100%
Random Triggering	4B12.31	100%

(a) These tests shall be performed prior to and after each environmental test.

APPENDIX 4B12
TRANSPONDER TEST REQUIREMENTS

Table 4B12-1
Transponder Acceptance Test Matrix
(Page 2 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED
Functional Tests (continued) *(a)*		
Decoder Immunity (0 dBm)	4B12.32	100%
Pulse Amplitude Variations	4B12.33	100%
Pulse Amplitude Jitter	4B12.34	100%
Over Interrogation	4B12.35	100%
Carrier Phase Coherency	4B12.36	100%
Carrier Line Width (3 dB)	4B12.37	100%
Spectral Skew	4B12.38	100%
Interline Noise (relative)	4B12.39	100%
Dynamic Pulse Spectrum	4B12.40	100%
Frequency Tracking	4B12.41	100%
Signal Strength Monitor	4B12.42	100%
Reference Functional Tests *(b)*		
Threshold Sensitivity	4B12.13	100%
Random Triggering	4B12.31	100%
Peak Power Output	4B12.7	100%
Transmit Frequency	4B12.4	100%
Delay Var. vs Sig. Strength (dBm)	4B12.18	100%
Delay Variation vs PRF (pps)	4B12.22	100%
Reply Delay (-55 dBm)	4B12.17	100%
Operating Environment Tests		
Acoustic	4B1.4.2.2	100%
Acceleration	4B1.4.2.3	100%
Thermal Cycling *(c)*	4B1.4.2.4	100%
Thermal Vacuum *(d)*	4B1.4.2.5	100%
Random Vibration	4B1.4.2.1	100%
Burn-in	4B1.4.2.6	100%
Leakage *(e)*	4B1.2.7	100%

(a) These tests shall be performed prior to and after each environmental test.
(b) These tests shall be performed or monitored to the maximum extent possible during the operating environment test.
(c) Reference functional tests shall be performed at high voltage input on the 1 and 7 cycles, low voltage input on the 2 and 8 cycles, and reference functional tests for the remaining cycles at nominal voltage input.
(d) Perform reference functional test during the high and low temperatures soak periods.
(e) This test shall be performed after the last operating environment test.

APPENDIX 4B12
TRANSPONDER TEST REQUIREMENTS

Table 4B12-2
Transponder Qualification Test Matrix
(Page 1 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		1	1	1
Acceptance Test	ACCEPTANCE TEST MATRIX	X	X	X
Functional Test *(a)*				
Continuity & Isolation	4B12.1	X	X	X
Time To See (delay timer)	4B12.2	X	X	X
Time To Stabilize	4B12.3	X	X	X
Transmit Frequency	4B12.4	X	X	X
Frequency Drift Rate	4B12.5	X	X	X
Peak Power Output	4B12.7	X	X	X
Pulse Width	4B12.8	X	X	X
Pulse Rise Time	4B12.9	X	X	X
Pulse Fall Time	4B12.10	X	X	X
Pulse Width Jitter	4B12.11	X	X	X
Pulse RF Spectrum (6 dB B/W)	4B12.12	X	X	X
Measured RF Threshold Sensitivity	4B12.13	X	X	X
Receiver Bandwidth (3 dB)	4B12.14	X	X	X
Receiver Bandwidth (40 dB)	4B12.15	X	X	X
Image Rejection	4B12.16	X	X	X
Reply Delay (-55 dBm)	4B12.17	X	X	X
Delay Variation vs Signal Strength (dBm)	4B12.18	X	X	X
Delay Jitter vs Signal Strength (dBm)	4B12.19	X	X	X
Delay Variation vs Freq.(MHz)	4B12.20	X	X	X
Delay Jitter vs Freq. (MHz)	4B12.21	X	X	X
Delay Variation vs PRF (pps)	4B12.22	X	X	X
Delay Jitter vs PRF (pps)	4B12.23	X	X	X
Delay Variation vs Operating Voltage	4B12.24	X	X	X
Delay Jitter vs Operating Voltage	4B12.25	X	X	X
Operating Current vs Operating Voltages	4B12.26	X	X	X
Decoder Accept Limits	4B12.27	X	X	X
Decoder Reject Limits	4B12.28	X	X	X
Pulse Width Acceptance	4B12.29	X	X	X
Recovery Time (0 dBm)	4B12.30	X	X	X
Random Triggering	4B12.31	X	X	X
Decoder Immunity (0 dBm)	4B12.32	X	X	X
Pulse Amplitude Variations	4B12.33	X	X	X
Pulse Amplitude Jitter	4B12.34	X	X	X
Over Interrogation	4B12.35	X	X	X
Carrier Phase Coherency	4B12.36	X	X	X
Carrier Line Width (3 dB)	4B12.37	X	X	X
Spectral Skew	4B12.38	X	X	X
Interline Noise (relative)	4B12.39	X	X	X
Dynamic Pulse Spectrum	4B12.40	X	X	X
Frequency Tracking	4B12.41	X	X	X
Signal Strength Monitor	4B12.42	X	X	X
CW Immunity	4B12.43	X	X	X

(a) These tests shall be performed prior to and after each environmental test.

APPENDIX 4B12
TRANSPONDER TEST REQUIREMENTS

Table 4B12-2
Transponder Qualification Test Matrix
(Page 2 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		1	**1**	**1**
Reference Functional Tests *(b)*				
Threshold Sensitivity	4B12.13	X	X	X
Random Triggering	4B12.31	X	X	X
Peak Power Output	4B12.7	X	X	X
Transmit Frequency	4B12.4	X	X	X
Delay Variation vs Signal Strength (dBm)	4B12.18	X	X	X
Delay Variation vs PRF (pps)	4B12.22	X	X	X
Reply Delay (-55 dBm)	4B12.17	X	X	X
Non-Operating Environment Tests				
Storage Temperature	4B1.3.1	X	X	X
Transport Shock/Bench Handling	4B1.3.3	X	X	X
Transportation Vibration	4B1.3.4	X	X	X
Fungus Resistance	4B1.3.5	X		
Salt Fog	4B1.3.6	X		
Fine Sand	4B1.3.7		X	
Operating Environment Tests				
Sinusoidal Vibration	4B1.4.1.1	X	X	X
Acoustic	4B1.4.1.3	X	X	X
Shock	4B1.4.1.4	X	X	X
Acceleration	4B1.4.1.5	X	X	X
Humidity	4B1.4.1.6			X
Thermal Cycling *(c)*	4B1.4.1.7	X	X	X
Thermal Vacuum *(d)*	4B1.4.1.8	X	X	X
Random Vibration	4B1.4.1.2	X	X	X
EMI/EMC	4B1.4.1.9		X	X
Explosive Atmosphere	4B1.4.1.10	X		
Leakage *(e)*	4B1.2.7	X	X	X
Disassembly	4B1.4.1.11	X	X	X

(b) This test shall be performed or monitored to the maximum extent possible during the operating environment tests.
(c) Reference functional tests shall be performed at high voltage input on the 1 and 23 cycles, nominal voltage on the 12 and 13 cycles, low voltage input on the 2 and 24 cycles, and reference functional tests for the remaining cycles at nominal voltage input.
(d) Perform reference functional test during the high and low temperatures soak periods of first and last cycles.
(e) This test shall be performed after the last non-operating and the last operating environment test.

APPENDIX 4B12
TRANSPONDER TEST REQUIREMENTS

NOTE: Unless otherwise specified in the individual test, all tests shall be performed at the transponder guarantee RF threshold sensitivity level (usually -70 dBm).

4B12.1 Continuity & Isolations

a. Verify that the transponder continuity and isolation resistances between the case ground and all power leads, and signal outputs, including returns, and between power leads and signal leads, including returns are within the requirements that are specified in the component specification.

b. Measure all external parts of the unit to verify that they are at case ground potential.

4B12.2 Time To See - Power Delay Timer

a. Verify that the transponder power supply delay timer is working.

b. Measure the delay time.

c. Record the time in seconds.

4B12.3 Time To Stabilize

a. Determine at which 30 sec interval, after the first application of DC power, the transponder reply frequency begins to drift less than 0.5 MHz per 30 second period.

b. Record the time in seconds.

4B12.4 Transmit Frequency

a. At 180 sec after application of DC power to the transponder, measure and record the transponder transmit frequency as "Start +3 min".

b. At 600 sec of transponder reply, measure and record the transponder transmit frequency as "Stop +10 min". Record the transmit frequency in megahertz (MHz).

4B12.5 Frequency Drift Rate

a. Measure the difference between the minimum and the maximum reply frequency measurements that were recorded during the first 180 sec of application of DC power to the transponder in the **Transmit Frequency** section of this Appendix.

b. Divide this difference by the number of minutes during which the measurements were obtained.

c. Record the quotient in MHz.

4B12.6 Intentionally Left Blank

4B12.7 Peak Power Output

a. Measure the actual transponder peak power output.

b. Record the measurement in watts.

4B12.8 Pulse Width

a. Measure the width of the transponder reply pulse at the medial point of the pulse.

b. Record the measurement in microseconds.

4B12.9 Pulse Rise Time

a. Measure the transponder reply pulse rise time. **NOTE**: The rise time is the time between the 10 percent and the 90 percent amplitude points of the leading edge of the unsaturated reply pulse.

b. Record the rise time in microseconds.

4B12.10 Pulse Fall Time

a. Measure the transponder reply pulse fall time. **NOTE**: The fall time is the time between the 90 percent and the 10 percent amplitude points of the falling edge of the unsaturated reply pulse.

b. Record the fall time in microseconds.

4B12.11 Pulse Width Jitter

a. Measure the transponder reply pulse width jitter. **NOTE**: Measure the pulse width variations at the 50 percent amplitude points of each pulse, one standard deviation value of 1000 samples.

b. Record the measurement in microseconds.

4B12.12 Pulse RF Spectrum at the 6 dB Bandwidth point

Measure the transponder reply RF bandwidth at the -6 dB (1/4th power) RF spectrum points. **NOTE**: Normally performed with a spectrum analyzer and recorded in MHz.

4B12.13 Measured RF Threshold Sensitivity

a. Measure the minimum RF that is required to interrogate the transponder at the assigned interrogation RF frequency. **NOTE**: A valid reply is defined as no more than 1 percent missing reply pulses.

b. Record the measurement in dBm.

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TRANSPONDER TEST REQUIREMENTS

4B12.14 Receiver Bandwidth (3 dB)

a. Measure the bandwidth, at the 3 dB points, of the transponder receiver. **NOTE**: The bandwidth is defined as the frequency point where the transponder continues to reply with no more than 1 percent missing pulses.

b. Record the measurement in MHz.

4B12.15 Receiver Bandwidth (40 dB)

a. Measure the bandwidth, at the 40 dB points, of the transponder receiver. **NOTE**: The bandwidth is defined as the frequency point where the transponder continues to reply with no more than 1 percent missing pulses.

b. Record the measurement in MHz.

4B12.16 Image Rejection

a. Measure the transponders receiver image rejection quality. **NOTE**: This measurement is obtained with the rise and fall time of the interrogation pulses adjusted to 100 nanoseconds, or as slow as possible, and the RF input set to 0 dBm. The interrogation RF frequency is set to the image frequency of the transponder. The image frequency is determined by:

$$F_{image} = 2(FLO) - F_o$$

where:

Fimage = Image frequency
FLO = Local oscillator frequency of the transponder in MHz
F_o = Center frequency (MHz) to which the transponder is tuned

b. Record the measurement in dB.

4B12.17 Reply Delay (-55 dBm)

a. Measure the transponder fixed delay with the interrogation signal RF level set to -55 dBm. **NOTE**: Measure the time in microseconds, ±0.01 microseconds, between the 50 percent amplitude point on the leading edge of the second interrogate pulse and the 50 percent amplitude point on the leading edge of the unsaturated reply pulse. Delays of the test system shall be subtracted.

b. Record the measurement in microseconds.

4B12.18 Delay Variation vs Signal Strength (dBm)

NOTE: Each delay measurement should be an average of 1000 samples.

a. Measure the transponder delay variations as a direct result of varying the signal strength of the interrogation signal. **NOTE**: Measure the reply delay, in microseconds ±0.01 microseconds, with the interrogation RF level set to 0, -10, -20, -30, -40, -50, -57, -60, -62, -65, -67, and - 70 dBm.

b. Record each delay measurement in microseconds.

c. Compute the difference between the maximum and the minimum delay measurements that are taken between the levels of 0 and -65 dBm and record this value as the delay variation vs signal strength in microseconds.

4B12.19 Delay Jitter vs Signal Strength (dBm)

NOTE: Each delay measurement should be an average of 1000 samples.

a. Measure the transponder delay jitter as a direct result of varying the signal strength of the interrogation signal.

b. Measure the total (one sigma) fluctuation in reply delay, in microseconds ±0.001 microseconds, with each of the RF interrogations levels set to 0, -10, -20, -30, -40, -50, -57, -60, -62, -65, -67, and -70 dBm.

c. Record the delay jitter maximum value in microseconds.

4B12.20 Delay Variation vs Frequency (MHz)

NOTE: Each delay measurement should be an average of 1000 samples.

a. Measure the transponder delay variation as a direct result of varying the frequency of the interrogation signal.

b. Measure the reply delay, in microseconds ±0.001 microseconds, with the interrogation signal level set to -55 dBm and the frequency changed in 0.5 MHz steps from 1.5 MHz above the transponder receiver assigned frequency to 1.5 MHz below the transponder receiver assigned frequency.

APPENDIX 4B12
TRANSPONDER TEST REQUIREMENTS

c. Record the delay, in microseconds, for -1.5, -1, -0.5, +0.5, +1, and +1.5 MHz.

d. Compute the difference between the minimum and the maximum delay measurements.

e. Record the delay variation vs frequency in microseconds.

4B12.21 Delay Jitter vs Frequency (MHz)

NOTE: Each measurement should be an average of 1000 samples.

a. Measure the transponder delay jitter as a direct result of varying the frequency of the interrogation signal.

b. Measure the standard deviation (one sigma) jitter in reply delay, in microseconds ±0.001 microseconds, with the interrogation signal level set to -55 dBm and the frequency changed to 0.5 MHz steps from 1.5 MHz above the transponder receiver assigned frequency to 1.5 MHz below the transponder receiver assigned frequency.

c. Record the delay, in microseconds, for -1.5, -1, -0.5, +0.5, +1, and +1.5 MHz.

d. Record the delay jitter maximum value in microseconds.

4B12.22 Delay Variation vs PRF (pps)

NOTE: Each measurement should be an average of 1000 samples.

a. Measure the transponder delay variation as a direct result of varying the pulse repetition frequency (pps) of the interrogation signal.

b. Measure the reply delay in microseconds, ±0.001 microseconds,

c. With the interrogation RF signal level set to -55 dBm, measure and record the delay, in microseconds, when the PRF is set to 160, 480, 800, 960, 1440, and 1600 pps.

d. Compute the difference between the minimum and the maximum delays and record delay variation vs PRF in microseconds.

4B12.23 Delay Jitter vs PRF (pps)

NOTE: Each measurement should be an average of 1000 samples.

a. Measure the transponder delay jitter as a direct result of varying the pulse repetition frequency (pps) of the interrogation signal.

b. Measure and record, in microseconds, the standard deviation (one sigma) jitter in reply delay, in microseconds ±0.001 microseconds, with the interrogation RF signal level set to -55 dBm and the PRF set to 160, 480, 800, 960, 1440, and 1600 pps.

c. Record the delay jitter maximum value in microseconds.

4B12.24 Delay Variation vs Operating Voltage

NOTE: Each measurement should be an average of 1000 samples.

a. Measure the transponder delay variation as a direct result of varying the transponder supply DC voltage.

b. Measure and record the reply delay, in microseconds ±0.001 microseconds, with the interrogation RF signal level set to -55 dBm and the DC supply voltage incremented in 2 volt steps from 24 to 32 Vdc.

c. Compute the difference between the minimum and the maximum delays.

d. Record delay variation vs operating voltage.

4B12.25 Delay Jitter vs Operating Voltage

NOTE: Each measurement should be an average of 1000 samples.

a. Measure the transponder delay jitter as a direct result of varying the transponder supply DC voltage.

b. Measure the standard deviation (one sigma) jitter in reply delay, in microseconds ±0.001 microseconds, with the interrogation RF signal level set to -55 dBm.

c. Measure and record the delay, in microseconds, when the DC supply voltage is incremented in 2 volt steps from 24 to 32 Vdc.

d. Record the delay jitter maximum value in microseconds.

4B12.26 Operating Current vs Operating Voltage

a. Measure the amount of current that the transponder requires for the operating voltage supplied.

b. Measure and record the amount of current drawn by the transponder while the DC power source is set to 24, 26, 28, 30, and 32 Vdc.

c. Record the measurement in amps or milliamps as appropriate.

4B12.27 Decoder Accept Limits

a. Measure the upper and lower limits of the interrogation pulse code spacing. Set the RF amplitude to -55 dBm, and vary the code spacing of the interrogation pulses. **NOTE**: The upper and lower limits are where the transponder first indicates 1 percent missing pulses.

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b. Record the upper and lower limits in microseconds. **NOTE**: The 1 percent missing pulse is referenced to 1000 pulses.

c. Compute and record the center as the average of the upper and lower limits.

4B12.28 Decoder Reject Limits

a. Measure the interrogation code spacing where the transponder fails to reply (99 percent missing pulses out of 1000 interrogations). **NOTE**: This measurement is obtained by varying the code spacing of the interrogation above and below the assigned code spacing while observing the transponder reply for evidence of 99 percent missing reply pulses. The points where the reply pulse first indicates 99 percent missing reply pulses.

b. Record the measurement in microseconds.

4B12.29 Pulse Width Acceptance

a. Measure the minimum and the maximum interrogation pulse widths that the transponder will respond to with no more than 1 percent missing pulses out of 1000 interrogations. **NOTE**: This measurement is obtained by varying the interrogation pulse width from nominal until the transponder reflects 1 percent missing reply pulses. The pulse width is measured at the 50 percent point of the leading edge of the interrogation pulse.

b. Record the low and the high acceptance limits in microseconds.

4B12.30 Recovery Time (0 dBm)

a. Determine the minimum time that is permissible between interrogations that will allow the transponder to recover with no more than 1 percent missing pulses. **NOTE**: The repetition period between the two groups of pulses is reduced to a point where the reply pulse from the second group of interrogation pulses indicates no more than 1 percent missing returns.

b. Record the time in microseconds.

4B12.31 Random Triggering

a. Determine if the transponder has any random replies. **NOTE**: This test is conducted at high RF input level (0 dBm) and the transponder is monitored for random replies during both interrogation and non-interrogation conditions.

b. Record the number of replies that were observed in pps.

4B12.32 Decoder Immunity (0 dBm)

a. Determine if the transponder is immune to single pulse interrogation signals (only replies to double pulse coded signals). **NOTE**: The test is performed with the RF amplitude at a high level (0 dBm) and the interrogation set to single pulse.

b. Record the number of replies observed in pps.

4B12.33 Pulse Amplitude Variations

a. Determine the variations in the pulse amplitude. **NOTE**: The variations in pulse amplitude are measured at the top of each pulse while varying the interrogation signal amplitude, PRF and transponder DC input voltage.

b. Record the variations in dB.

4B12.34 Pulse Amplitude Jitter

a. Determine the jitter in the pulse-to-pulse amplitude. **NOTE**: The jitter in pulse-to-pulse amplitude is measured at the top of each pulse while varying the interrogation signal amplitude, PRF, and transponder DC input voltage.

b. Record the jitter in dB.

4B12.35 Overinterrogation

a. Determine the actual maximum interrogation rate that the transponder can continue to reply to with no more than 1 percent missing pulses.

b. Record the rate in pps.

4B12.36 Carrier Phase Coherency

a. Measure the coherency of coherent tracking transponders to the interrogation source. **NOTE**: The measurement compares the phase relationship of each reply pulse to the interrogation pulse, in a very large sample (usually 16,000) size.

b. Record the results in Hz for standard deviation and feet/second for velocity accuracy.

4B12.37 Carrier Line Width (3 dB)

a. Measure the width of the pulse in the RF domain of a coherent tracking transponder. **NOTE**: The pulse width is usually measured as a part of the **Carrier Phase Coherency** test described above.

b. Measure the fine line carrier at the 3 dB points and record the measurement in Hz.

4B12.38 Spectral Skew

a. Measure the spectral skew of the pulse RF

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carrier about the assigned center frequency of a coherent tracking transponder. **NOTE**: The amplitude of the pulsed spectrum is measured at the plus and minus 350 kHz points.

b. Record the difference in amplitude in dB.

4B12.39 Interline Noise (Relative)

a. Measure the noise level that is present on the RF spectrum between the modulating pulses on a coherent tracking transponder. **NOTE**: The measurement is the difference between the fine line pulse and the noise just preceding or following the fine line pulse.

b. Record the difference in dB.

4B12.40 Dynamic Pulse Spectrum

a. Measure the delta amplitude and the delta frequency of the first side lobe as compared to the main lobe of a coherent tracking transponder.

b. Record the measurements in delta Hz and delta dB.

4B12.41 Frequency Tracking

a. Measure the ability of a coherent tracking transponder to follow an interrogation source that is moving in frequency. **NOTE**: The measurement is the point when the transponder reply frequency is 1.0 MHz different from the interrogation source.

b. Record the high and low limits in MHz.

4B12.42 Signal Strength Monitor

Determine the transponder signal strength monitor voltage (Automatic Gain Control (AGC)) when the transponder is designed for an appropriate output voltage that represents the SST voltage. **NOTE**: This test is an x-y plot of an RF interrogation signal strength verses SST voltage in increments of no more than 2 dB from the measured RF threshold sensitivity to 0 dBm.

4B12.43 CW Immunity

Verify the transponder does not respond to CW signal at RF amplitude between 0 and -55 dBm (in 10 dB steps).

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Table 4B13-1
Digital Translator Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Product Examination		
Visual	4B1.2.1	100%
Weight	4B1.2.2	100%
Dimension	4B1.2.3	100%
Identification	4B1.2.4	100%
Functional Test *(a)*		
Continuity & Isolation	4B13.1	100%
DC Input Voltage	4B13.2	100%
Input Current	4B13.3	100%
Noise Figure	4B13.4	100%
Pseudo-Range	4B13.5	100%
Time Delay	4B13.6	100%
S-Band Frequency Stability	4B13.7	100%
S-Band Frequency Accuracy	4B13.8	100%
Power Output	4B13.9	100%
S-Band Frequency Drift	4B13.10	100%
S-Band Spectral Charac. & Spurious Emissions	4B13.11	100%
Carrier Suppression	4B13.12	100%
Apparent Bandwidth (30 dB)	4B13.13	100%
Phase Linearity	4B13.14	100%
Bit Error Rate	4B13.15	100%
L_1/L_2 Bandpass Character	4B13.16	100%
Phase Jitter	4B13.17	100%
Out-of-Band Signals	4B13.20	100%
Reference Functional Test *(b)*		
Input Current	4B13.3	100%
Power Output	4B13.9	100%
S-Band Frequency Stability	4B13.7	100%
Phase Linearity	4B13.14	100%
Phase Jitter	4B13.17	100%
Operating Environment Test		
Acoustic	4B1.4.2.2	100%
Acceleration	4B1.4.2.3	100%
Thermal Cycling *(c)*	4B1.4.2.4	100%
Thermal Vacuum *(d)*	4B1.4.2.5	100%
Random Vibration	4B1.4.2.1	100%
Burn-In	4B1.4.2.6	100%
Leakage *(e)*	4B1.2.7	100%

(a) These tests shall be performed prior to and after each environmental test.
(b) These tests shall be performed or monitored to the maximum extent possible during the operating environment tests.
(c) Full functional tests shall be performed at high voltage on the 1 and 7 cycles, low voltage input on the 2 and 8 cycles, and reference functional tests for the remaining cycles at nominal voltage input.
(d) Perform reference functional test during the high and low temperature soak periods.
(e) This test shall be performed after the last operating environment test.

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GLOBAL POSITIONING SYSTEM TEST REQUIREMENTS

Table 4B13-2
Digital Translator Qualification Test Matrix
(Page 1 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		1	**1**	**1**
Perform Acceptance Test)	ACCEPTANCE TEST MATRIX	X	X	X
Functional Test *(a)*				
Continuity & Isolation	4B13.1	100%		
DC Input Voltage	4B13.2	100%		
Input Current	4B13.3	100%		
Noise Figure	4B13.4	100%		
Pseudo-Range	4B13.5	100%		
Time Delay	4B13.6	100%		
S-Band Frequency Stability	4B13.7	100%		
S-Band Frequency Accuracy	4B13.8	100%		
Power Output	4B13.9	100%		
S-Band Frequency Drift	4B13.10	100%		
S-Band Spectral Characteristics & Spurious Emissions	4B13.11	100%		
Carrier Suppression	4B13.12	100%		
Apparent Bandwidth (30 dB)	4B13.13	100%		
Phase Linearity	4B13.14	100%		
Bit Error Rate	4B13.15	100%		
L_1/L_2 Bandpass Character	4B13.16	100%		
Phase Jitter	4B13.17	100%		
Out-of-Band Signals	4B13.20	100%		
Reference Functional Test *(b)*				
Input Current	4B13.2	100%		
Power Output	4B13.9	100%		
S-Band Frequency	4B13.7	100%		
Phase Linearity	4B13.14	100%		
Phase Jitter	4B13.17	100%		
One-Time Special Tests *(c)*				
Peak Input Voltage	4B13.18	X	X	X
RF Overload	4B13.19	X	X	X
Non-Operating Environment Tests				
Storage Temperature	4B1.3.1	X	X	X
Transport Shock/Bench Handling	4B1.3.3	X	X	X
Transportation Vibration	4B1.3.4	X	X	X
Fungus Resistance	4B1.3.5	X		
Salt Fog	4B1.3.6	X		
Fine Sand	4B1.3.7		X	

(a) These tests shall be performed prior to and after each environmental test.
(b) These tests shall be performed or monitored to the maximum possible extent during the operating environment tests.
(c) Perform these tests once per unit.

APPENDIX 4B13
GLOBAL POSITIONING SYSTEM TEST REQUIREMENTS

Table 4B13-2
Digital Translator Qualification Test Matrix
(Page 2 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		1	1	1
Operating Environment Tests				
Sinusoidal Vibration	4B1.4.1.1	X	X	X
Acoustic	4B1.4.1.3	X	X	X
Shock	4B1.4.1.4	X	X	X
Acceleration	4B1.4.1.5	X	X	X
Humidity	4B1.4.1.6		X	
Thermal Cycling *(d)*	4B1.4.1.7	X	X	X
Thermal Vacuum *(e)*	4B1.4.1.8	X	X	X
Random Vibration	4B1.4.1.2	X	X	X
EMI/EMC	4B1.4.1.9		X	
Explosive Atmosphere	4B1.4.1.10	X		
Leakage *(f)*	4B1.2.7	X	X	X
Disassembly	4B1.4.2.7			X

(d) Full functional tests shall be performed at high voltage input on the 1 and 23 cycles, nominal voltage on the 12 and 13 cycles, low voltage input on the 2 and 24 cycles, and reference functional tests for the remaining cycles at nominal voltage input.

(e) Perform reference functional test during the high and low temperature soak periods of the first and last cycles.

(f) Full functional tests shall be performed at high voltage on the 1 and 7 cycles, low voltage input on the 2 and 8 cycles, and reference functional tests for the remaining cycles at nominal voltage input.

(g) This test shall be performed after the last operating environment test.

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GLOBAL POSITIONING SYSTEM TEST REQUIREMENTS

Table 4B13-3
GPS Receiver Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Product Examination		
Visual	4B1.2.1	100%
Weight	4B1.2.2	100%
Dimension	4B1.2.3	100%
Identification	4B1.2.4	100%
Functional Test *(a)*		
Continuity & Isolation	4B13.21	100%
DC Input Voltage	4B13.22	100%
Input Current	4B13.23	100%
Noise Figure	4B13.24	100%
System Test	4B13.25	100%
Phase Linearity	4B13.26	100%
L_1/L_2 Bandpass Character	4B13.27	100%
Phase Jitter	4B13.28	100%
Sensitivity	4B13.29	100%
Rapid Relock Test	4B13.30	100%
Time to First Fix	4B13.31	100%
Deselection Faulty Satellites	4B13.32	100%
Immunity to In-Band Signals	4B13.33	100%
Out-of-Band Signals	4B13.34	100%
Reference Functional Test *(b)*		
Input Current	4B13.23	100%
System Test	4B13.25	100%
Phase Linearity	4B13.26	100%
Phase Jitter	4B13.28	100%
Operating Environment Test		
Acoustic	4B1.4.2.2	100%
Acceleration	4B1.4.2.3	100%
Thermal Cycling *(c)*	4B1.4.2.4	100%
Thermal Vacuum *(d)*	4B1.4.2.5	100%
Random Vibration	4B1.4.2.1	100%
Burn-In	4B1.4.2.6	100%
Leakage *(e)*	4B1.2.7	100%

(a) These tests shall be performed prior to and after each environmental test.
(b) These tests shall be performed or monitored to the maximum extent possible during the operating environment tests.
(c) Full functional tests shall be performed at high voltage on the 1 and 7 cycles, low voltage input on the 2 and 8 cycles, and reference functional tests for the remaining cycles at nominal voltage input.
(d) Perform reference functional test during the high and low temperature soak periods.
(e) This test shall be performed after the last operating environment test.

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GLOBAL POSITIONING SYSTEM TEST REQUIREMENTS

Table 4B13-4
GPS Receiver Qualification Test Matrix
(Page 1 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		1	1	1
Acceptance Tests	ACCEPTANCE TEST MATRIX	X	X	X
Functional Tests *(a)*				
Continuity & Isolation	4B13.21	X	X	X
DC Input Voltage	4B13.22	X	X	X
Input Current	4B13.23	X	X	X
Noise Figure	4B13.24	X	X	X
System Test	4B13.25	X	X	X
Phase Linearity	4B13.26	X	X	X
L_1/L_2 Bandpass Character	4B13.27	X	X	X
Phase Jitter	4B13.28	X	X	X
Sensitivity	4B13.29	X	X	X
Rapid Relock Test	4B13.30	X	X	X
Time to First Fix	4B13.31	X	X	X
Deselect Faulty Satellites	4B13.32	X	X	X
Immunity to In-Band Signals	4B13.33	X	X	X
Out-of-Band Signals	4B13.34	X	X	X
Reference Functional Test *(b)*				
Input Current	4B13.23	X	X	X
System Test	4B13.25	X	X	X
Phase Linearity	4B13.26	X	X	X
Phase Jitter	4B13.28	X	X	X
One-Time Special Tests *(c)*				
Peak Input Voltage	4B13.35	X	X	X
RF Overload	4B13.36	X	X	X
Non-Operating Environment Tests				
Storage Temperature	4B1.3.1	X	X	X
Transport Shock/Bench Handling	4B1.3.3	X	X	X
Transportation Vibration	4B1.3.4	X	X	X
Fungus Resistance	4B1.3.5	X		
Salt Fog	4B1.3.6	X		
Fine Sand	4B1.3.7		X	

(a) These tests shall be performed prior to and after each environmental test.
(b) These tests shall be performed or monitored to the maximum extent possible during the operating environment tests.
(c) Perform these tests once per unit.

APPENDIX 4B13
GLOBAL POSITIONING SYSTEM TEST REQUIREMENTS

Table 4B13-4
GPS Receiver Qualification Test Matrix
(Page 2 of 2)

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		1	**1**	**1**
Operating Environment Tests				
Sinusoidal Vibration	4B1.4.1.1	X	X	X
Acoustic	4B1.4.1.3	X	X	X
Shock	4B1.4.1.4	X	X	X
Acceleration	4B1.4.1.5	X	X	X
Humidity	4B1.4.1.6			X
Thermal Cycling *(d)*	4B1.4.1.7	X	X	X
Thermal Vacuum *(e)*	4B1.4.1.8	X	X	X
Random Vibration	4B1.4.1.2	X	X	X
EMI/EMC	4B1.4.1.9			X
Explosive Atmosphere	4B1.4.1.10	X		
Leakage *(f)*	4B1.2.7	X	X	X
Disassembly	4B1.4.2.7			X

(d) Full functional tests shall be performed at high voltage input on the 1 and 23 cycles, nominal voltage on the 12 and 13 cycles, low voltage input on the 2 and 24 cycles, and reference functional tests for the remaining cycles at nominal voltage input.

(e) Perform reference functional test during the high and low temperature soak periods of the first and last cycles.

(f) This test shall be performed after the last non-operating and the last operating environment test.

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GLOBAL POSITIONING SYSTEM TEST REQUIREMENTS

DIGITAL TRANSLATOR

NOTE: The digital translator shall be tested at the frequencies incorporated (it shall be tested in the flight configuration). For example, if the translator is constructed to translate L_1 and L_2 data, then both frequencies must be tested during all applicable acceptance tests, even if only one of the two frequencies is intended for operational use. If an incorporated L-Band link carries both the CA code and the P code, then both codes must be processed by the ground station. Also, the digital translator must be tested at the telemetry bandwidth that will be employed operationally. Use of encryption modes must be approved by the Range; for approved encryption schemes, all applicable tests must be performed in the encrypted mode during acceptance and qualification testing. Finally, telemetry channels incorporated in digital translator-design to report state-of-the-health of the translator must be tested during acceptance testing.

4B13.1 Continuity and Isolation

The translator continuity and isolation resistance shall be verified between case ground and all power leads, and signal outputs, including returns, and between power leads and signal leads, including returns. All external parts of the unit shall be measured to verify they are at case ground potential. Isolation values will be specified in the applicable specification.

4B13.2 DC Input Voltage

The purpose of this test is to verify that translator power consumption is within the limits specified for normal operations. This test will also ensure that the translator will function normally at all voltage requirements as specified by the applicable specification. The DC power supply is to be varied from specified minimum to maximum.

4B13.3 Input Current

The maximum current shall be measured at the low, nominal, and high supply voltages.

4B13.4 Noise Figure

The noise figure for the digital translator shall be measured at 1574, 1575, and 1576 MHz for noise source applied at the L_1 input and at 1226, 1227, and 1228 MHz for noise applied at the L_2 input. This measurement must be made at a point before signals are quantized for digital processing. Alternate test points and techniques must be approved by the Range (example, drop lock test).

4B13.5 Pseudo-Range

The translator shall be connected to a GPS signal simulator generating signals of known frequency, timing, and a range of signal levels. A Translator Processing System shall be used to recover the digitized GPS signal, track the signals, and measure the frequency timing. If antenna multiplexing is used, separate trackers shall be used for the signals from each antenna input. The standard deviation of the carrier of the recovered signal from the reference signal shall be less than .1 Hz. The standard deviation of the measured range from the predicted range shall be less than 20 nanoseconds following allowance for any known system biases such as filter delays and quadraphase demodulation. Additionally, this test shall be conducted at input signal levels below and above translator sensitivity to establish the threshold sensitivity of the device under test. Finally, the test shall be conducted repetitively by ramping the signal simulator from 0 to 10g to demonstrate proper performance under a full range of accelerations.

4B13.6 Time Delay

An observable signal shall be provided at the digital translator L_1/L_2 inputs; delay time shall be measured. If a quadrature phase shift key (QPSK) demodulator is used, the delay time associated with the demodulator must be measured before the test and “subtracted out” for the final value. This test will be performed at -145 dBm and -110 dBm input signal power.

4B13.7 S-Band Frequency Stability

This test measures RF frequency of the digital translator S-Band output and verifies compliance with assigned center frequency. This test should be performed in conjunction with the Power Output test. S-Band output frequency (unmodulated) should be measured at power on plus 1, plus 2, plus 3, plus 4, and plus 5 minutes. Record each

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reading in MHz. If the GPS ground station provides sufficient measurement accuracy, it may be used for this test.

4B13.8 S-Band Frequency Accuracy

The digital translator shall be tested for frequency accuracy of the unmodulated suppressed carrier. If the GPS ground station provides sufficient measurement accuracy, it may be used for this test.

4B13.9 Power Output

This test measures the specified power output from the translator. This test should be performed in conjunction with the S-Band Transmit Frequency Stability test. Power output should be measured at power on, and at plus 1, plus 2, plus 3, plus 4, and plus 5 minutes. Record each reading in dBm.

4B13.10 S-Band Carrier Frequency Drift

This test measures S-Band carrier frequency drift for comparison of the suppressed carrier frequency with specified value. The Allan variance technique shall be used with a minimum of 50 data points for each variance calculation.

4B13.11 S-Band Spectral Characteristics and Spurious Emissions

This test establishes the spectral characteristics of the digital translator S-Band downlink and checks for spurious emissions. For the first test, the spectrum analyzer shall be set up using assigned center frequency, span should cover the spectral profile for the modulated S-Band output ±1 MHz, video bandwidth of 30 Hz, and resolution bandwidth of 3 kHz. The second test expands the span to 100 MHz and uses the same center frequency, video bandwidth, and resolution bandwidth. Spectral plots for both tests shall be included in the test report.

4B13.12 Carrier Suppression

This test measures the amount of carrier present in the S-Band downlink.

4B13.13 Apparent Bandwidth (30 dB)

This test measures the apparent bandwidth of the S-Band downlink.

4B13.14 Phase Linearity

A continuous wave signal shall be provided at the digital translator L_1/L_2 port. The input signal shall be swept from 1574 to 1576 MHz and 1226 to 1228 MHz in 100 kHz increments. Phase slope will be calculated for each measurement and plotted. Plots will be included in the test report. Measurements must be made at a point before signals are quantized for digital processing. Alternate test points and techniques must be approved by the Range.

4B13.15 Bit Error Rate

The bit error rate for digital translator (DGT)-generated telemetry shall be measured for compliance with specifications. The input shall be an operationally representative set of signals. The demodulated output shall be compared to the reference input and the bit error rate shall be included in the test report.

4B13.16 L_1/L_2 Bandpass Characteristics

A continuous wave input signal (-110 dBm) shall be provided at the digital translator L_1/L_2 input ports. The signal shall be stepped from 1100 MHz to 1700 MHz in 100 kHz increments. Results will be plotted and included in the test report. Measurements must be made at a point before signals are quantized for digital processing. Alternate test points and techniques must be approved by the Range.

4B13.17 Phase Jitter

The digital translator will be placed on a vibration table to measure phase jitter. The input signal is continuous wave; jitter will be monitored while the unit is vibrated at the maximum predicted environment for 3 minutes per axis. Measurements must be made at a point before signals are quantized for digital processing.

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GLOBAL POSITIONING SYSTEM TEST REQUIREMENTS

Alternate test points and techniques must be approved by the Range (example, standard deviation of range rate measured by GPS ground station and codes).

4B13.18 Peak Input Voltage

This test verifies that the digital translator can withstand a 45 Vdc input.

4B13.19 RF Overload

This test verifies that the digital translator can withstand an in-band RF overload level of 10 dBm for 1 minute without degradation after overload is removed.

4B13.20 Susceptibility to Large Out-of-Band Signals

Susceptibility to combinations of up to and including three out-of-band continuous wave signals shall be tested for compliance with specifications. Reduction of C/N_0 for the following signals shall be measured and included in the acceptance test report per Table 4B13-5.

Table 4B13-5
Interfering Frequency

Frequency (MHz)	Signal Level (dBm)
100 < Fi ≤ 1496	-30
1496 < Fi ≤ 1565	1455.42 - F1
1585 < Fi ≤ 1655	1694.58 - F1
1555 < Fi ≤ 12000	-30

RECEIVER

4B13.21 Continuity & Isolation

The receiver continuity and isolation resistance shall be verified between case ground and all power leads, and signal outputs, including returns, and between power leads and signal leads, including returns. All external parts of the unit shall be measured to verify they are at case ground potential. Isolation values will be specified in the applicable specification.

4B13.22 DC Input Voltage

The purpose of this test is to verify that receiver power consumption is within the limits specified for normal operations. This test will also ensure that the receiver will function normally at all voltage requirements as specified by the applicable specification. The DC power supply is to be verified from specified minimum to maximum.

4B13.23 Input Current

The maximum current shall be measured at the low, nominal, and high supply voltage.

4B13.24 Noise Figure

The noise figure for the receiver shall be measured at 1574, 1575, 1576 for noise applied at the L_1 input and at 1226, 1227, and 1228 MHz for noise applied at the L_2 input. This measurement must be made at a point before signals are quantized for digital processing. Alternate test points/techniques must be approved by the Range (example - drop lock test).

4B13.25 System Test

This test evaluates the receiver's ability to produce on accurate state vector as well as the full range of required telemetry data. The input to the receiver is a calibrated GPS signal simulator. The primary measurement will be an accurate state vector based upon satellite position data provided by the simulator. Also the receiver must provide correct telemetry data for satellite assignments, lock status, ephemeris ready, currency of ephemeris, pseudo and delta range, state vector quality, PDOP and GDOP, signal quality, C/N_o, satellite health bit, and age of data. These data shall be measured against reference inputs provided by the GPS signal simulator. Pseudo range rate shall be measured by ramping the GPS signal simulator from zero to 10 g's and comparing range rate derived by the receiver with range rate provided by the simulator. Pseudo-range and delta pseudo-range rate tests shall be performed at -145 and -100 dBm.

4B13.26 Phase Linearity

A continuous wave signal shall be provided at the receiver L_1/L_2 port. The input signal shall be swept from 1574 to 1576 MHz and 1226 to 1228 MHz in 100 kHz increments. Phase slope will be calculated for each measurement and plotted. Plots will be included in the Test Report. Measurements shall made at a point before signals are quantized for digital processing. Alternate test points/techniques shall be approved by the Range.

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GLOBAL POSITIONING SYSTEM TEST REQUIREMENTS

4B13.27 L_1/L_2 Bandpass Characteristics

A continuous wave input signal (-110 dBm) shall be provided at the receiver L_1/L_2 input ports. The signal shall be stepped from 1100 MHz to 1700 MHz in 100 kHz increments. Results will be plotted and included in the Test Report. Measurements must be made at a point before signals are quantized for digital processing. Alternative test points/techniques must be approved by the Range.

4B13.28 Phase Jitter

The receiver will be placed on a vibration table to measure phase jitter. The input signal is continuous wave; jitter will be monitored while the unit is vibrated at the maximum predicted environment for 3 minutes per axis. Measurements must be made at a point before signals are quantized for digital processing. Alternative test points/techniques must be approved by the Range (example-standard deviation of range rate measured by GPS ground station).

4B13.29 Sensitivity

This test shall measure the minimum input level at which the receiver maintains lock and produces an accurate state vector. The input is a calibrated GPS signal simulator providing at least 4 satellites. Unless the receiver is capable of operating on only one L-Band frequency, both L_1 and L_2 center frequencies shall be tested for sensitivity. The codes (CA and/or P) that will be employed operationally must be used during this test.

4B13.30 Rapid Relock Test

This test shall verify the receiver's ability to relock after loss of a satellite and after the receiver's internal selection routine changes primary assignment. The input is a calibrated GPS signal simulator configured to drop one satellite and to provide geometry that will cause the receiver to change assignment during simulated flight.

Position uncertainty, velocity uncertainty, acceleration uncertainty, relock time, and time of change of assignment will be recorded. Acceleration and jerk profiles will replicate vehicle dynamics for staging during the relock test.

4B13.31 Time to First Fix

Time to first fix shall be measured using a GPS signal simulator. The simulator shall inject signals for individual satellites ranging from -145 dBm to -135 dBm to represent a mix of levels representative of the operating environment.

4B13.32 Deselection of Faulty Satellites

This test shall verify the receiver's ability to identify and reject faulty signals from satellites. The input is a -145 dBm signal from a calibrated GPS signal simulator. The simulator shall be configured to suddenly change key parameters. The receiver's ability to identify and reject the faulty satellite, select another satellite, and provide a correct state vector using the new satellite shall be recorded. During this test, the receiver should be tracking several satellites to demonstrate that measurements from the faulty satellite are not used in computation of position and velocity.

4B13.33 Immunity to In-Band Interfering Signals

The receiver's immunity to specified amplitudes and frequencies of in-band interfering signals shall be measured and reported.

4B13.34 Out-of-Band Signals

This test measures the receiver's susceptibility to signals and combinations of signals provided in the receiver specification. Reduction of C/N_o in the presence of large out-of-band signals shall be measured and recorded.

4B13.35 Peak Input Voltage

This test verifies that the receiver can withstand a 45 Vdc input.

4B13.36 RF Overload

This test verifies that the receiver can withstand an in-band RF overload of specified value without degradation after the overload is removed.

APPENDIX 4B14
TELEMETRY DATA TRANSMITTER TEST REQUIREMENTS

Table 4B14-1
Telemetry Transmitter Acceptance Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED
Product Examination		
Visual	4B1.2.1	100%
Weight	4B1.2.2	100%
Dimension	4B1.2.3	100%
Identification	4B1.2.4	100%
Functional Tests *(a)*		
Continuity & Isolation	4B14.1	100%
Power Output	4B14.2	100%
Frequency Stability	4B14.3	100%
Authorized Bdwidth and Spurious Emis.	4B14.4	100%
Carrier Suppression	4B14.5	100%
Apparent Bandwidth (30 dB)	4B14.6	100%
Accuracy	4B14.7	100%
Reference Functional Tests *(b)*		
Power Output	4B14.2	100%
Frequency Stability	4B14.3	100%
Modulation *(c)*	4B14.8	100%
Operating Environment Tests		
Acoustic	4B1.4.2.2	100%
Acceleration	4B1.4.2.3	100%
Thermal Cycling *(d)*	4B1.4.2.4	100%
Thermal Vacuum *(e)*	4B1.4.2.5	100%
Random Vibration	4B1.4.2.1	100%
Burn-in	4B1.4.2.6	100%
Leakage *(f)*	4B1.2.7	100%

(a) These tests shall be performed prior to and after each environmental test.
(b) These shall be monitored during the operating environment tests.
(c) To be performed and continuously monitored during random vibration test.
(d) Functional tests, except test 4B14.1, shall be performed at high voltage input on the 1 and 7 cycles, low voltage input on the 2 and 8 cycles, and reference functional tests for the remaining cycles at nominal voltage input.
(e) Perform the full functional test, except test 4B14.1, during the high and low temperature soak periods.
(f) This test shall be performed after the last operating environment test.

APPENDIX 4B14
TELEMETRY DATA TRANSMITTER TEST REQUIREMENTS

Table 4B14-2
Telemetry Transmitter Qualification Test Matrix

TEST	TEST REQUIREMENT	QUANTITY TESTED		
		1	**1**	**1**
Acceptance	ACCEPTANCE TEST MATRIX	X	X	X
Functional Tests *(a)*				
Continuity & Isolation	4B14.1	X	X	X
Power Output	4B14.2	X	X	X
Frequency Stability	4B14.3	X	X	X
Authorized Bandwidth and Spurious Emissions	4B14.4	X	X	X
Carrier Suppression	4B14.5	X	X	X
Apparent Bandwidth (30 dB)	4B14.6	X	X	X
Accuracy	4B14.7	X	X	X
Reference Functional Tests *(b)*				
Power Output	4B14.2	X	X	X
Frequency Stability	4B14.3	X	X	X
Modulation *(c)*	4B14.8	X	X	X
Non-Operating Environment Tests				
Storage Temperature	4B1.3.1	X	X	X
Transport Shock/Bench Handling	4B1.3.3	X	X	X
Transportation Vibration	4B1.3.4	X	X	X
Fungus Resistance	4B1.3.5	X		
Salt Fog	4B1.3.6	X		
Fine Sand	4B1.3.7		X	
Operating Environment Tests				
Sinusoidal Vibration	4B1.4.1.1	X	X	X
Acoustic	4B1.4.1.3	X	X	X
Shock	4B1.4.1.4	X	X	X
Acceleration	4B1.4.1.5	X	X	X
Humidity	4B1.4.1.6			X
Thermal Cycling *(d)*	4B1.4.1.7	X	X	X
Thermal Vacuum *(e)*	4B1.4.1.8	X	X	X
Random Vibration	4B1.4.1.2	X	X	X
EMI/EMC	4B1.4.1.9		X	X
Explosive Atmosphere	4B1.4.1.10	X		
Leakage *(f)*	4B1.2.7	X	X	X
Disassembly	4B1.4.2.7	X	X	X

(a) These tests shall be performed prior to and after each environmental test.
(b) These shall be monitored during the operating environment tests.
(c) To be performed and monitored continuously during random vibration test.
(d) Functional tests, except test 4B14.1, shall be performed at high voltage input on the 1 and 23 cycles, nominal voltage on the 12 and 13 cycles, low voltage input on the 2 and 24 cycles, and reference functional tests for the remaining cycles at nominal voltage input.
(e) Perform the full functional test, except test 4B14.1, during the high and low temperature soak periods of first and last cycle.
(f) This test shall be performed after the last non-operating and the last operating environment test.

APPENDIX 4B14
TELEMETRY DATA TRANSMITTER TEST REQUIREMENTS

4B14.1 Continuity & Isolations

a. Verify that the TDTS continuity and isolation resistances between the case ground and all power leads, and signal outputs, including returns, and between power leads and signal leads, including returns are within the requirements that are specified in the component specification.

b. Measure all external parts of the unit to verify that they are at case ground potential.

4B14.2 Power Output

a. Measure the specified power output from the transmitter. **NOTE**: This test should be performed in conjunction with the test in the **Frequency Stability** section of this Appendix. This test measures the power output at power on, and at power on plus 1, plus 2, plus 3, plus 4, and plus 5 minutes.

b. Record each reading in dBm.

4B14.3 Frequency Stability

a. Measure the RF frequency of the transmitter and verify that it complies with the assigned center frequency. **NOTE**: This test should be performed in conjunction with the **Power Output** section above. This test measures the transmitter frequency at power on and at power on plus 1, plus 2, plus 3, plus 4, and plus 5 minutes.

b. Record each reading in MHz.

4B14.4 Authorized Bandwidth and Spurious Emissions

a. Measure the authorized transmitter bandwidth and any spurious emissions that are present.

b. Record the bandwidth in MHz and note any spurious emissions.

NOTE: During this test the transmitter output carrier frequency shall be modulated in accordance with the flight operational modulation scheme. For example, if the modulation scheme employs phase shift keying (PSK), the carrier shall be PSK modulated using an operationally representative input (bit rate, return-to-zero scheme, and state transitions over time).

4B14.5 Carrier Suppression

Measure the amount of carrier that is present in the RF signal.

4B14.6 Apparent Bandwidth (30 dB)

a. Measure the apparent bandwidth of the transmitter at the 30 dB points.

b. Record the measurement in MHz.

4B14.7 Accuracy

a. Measure the PSK accuracy of the transmitter output and record the measurement in degrees of PSK, or

b. Measure the frequency shift keying accuracy of the transmitter output and record the measurement in kilohertz of carrier frequency shift.

4B14.8 Modulation

a. Measure the amplitude modulation (AM) and frequency modulation (FM) (both in the time and frequency domain) that is present when the transmitter output frequency is unmodulated (carrier only).

b. Record the modulation in percent for AM and kilohertz for FM.